THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXV JUNE, 1931 No. 6

COCCIDIOIDAL GRANULOMA: ROENTGEN DIAGNOSIS*

By RAY A. CARTER, M.D.

From the Department of Roentgenology, Los Angeles County General Hospital

LOS ANGELES, CALIFORNIA

THE first case of coccidioidal granuloma was observed by Posadas in Buenos Aires, reported by Wernicke[92] in 1892, and by Posadas[67] himself in 1900. The second and third cases were reported from California by Rixford[76] and Thorne[87] respectively in 1894. These two cases were reported in detail by Rixford and Gilchrist[77] in 1896, and the name *Coccidioides immitis* suggested for the organism. The observers so far considered the organism to be protozoan.

Ophüls and Moffit[65] reported the fourth case in 1900 and first demonstrated the organism to be a mold. They commented that "by some authors (Busse and others) they were at least suspected of being infections with vegetable organisms, most likely yeast fungi."

Further reports were made by Montgomery[57] (1900), Montgomery, Ryfkogel and Morrow[60] (1903), Wolbach[93] (1903), and Gardner and Halton[29] (1904).

Ophüls[63, 64] in 1905 published studies proposing the name *Oidium coccidioides* for the organism and coccidioidal granuloma for the disease.

From then on numerous case reports, studies and reviews have been made which may be classified by their prominent features as follows:

1. *Case Reports and Reviews.* Brown;[9, 10, 11] Bowles;[7] Burgess;[13] Burkhead;[15] Carson and Cummins;[16] Chipman;[17] Cummins, Smith and Halliday;[22] Dickson;[24] Gardner and Halton;[29] Hammack and Lacey;[31] Helsley;[33] Hirsch;[34] Kalichman and Madsen,[45] Kelton;[46] Lemon;[48] Lipsitz;[51] Lipsitz, Lawson and Fessenden;[52] Lynch;[53] MacNeal and Hjelm;[54] MacNeal and Taylor;[55] Montenegro;[56] Montgomery;[57] Montgomery, Ryfkogel and Morrow;[60] Proescher, Ryan and Krueger;[69] Pruett and Wayson;[70] Ragle;[72] Riesman and Ahlfeldt;[74] Roblee;[78] Seilin;[80] Stark and Becker;[82] Walters;[90] Wolbach.[94]

2. *Morphology and Cultural Characteristics.* de Area Leao;[1] Ahlfeldt;[2, 3] Brown and Cummins;[12] Bump;[14] Cummins and Sanders;[21] Hektoen;[32] Montgomery and Morrow;[58] Montgomery and Ormsby.[59]

3. *Specific Substances and Serology.* Cooke;[20] Cummins and Sanders;[21] Davis;[23] Hirsch and D'Andrea;[35, 36] Hirsch and Benson;[37] Jacobson.[41]

4. *Involvement of the Nervous System.* Evans;[27] Morris;[61] Rand;[73] Ryfkogel.[79]

5. *Treatment.* Guy and Jacob;[30] Jacobson;[40, 42, 43] Pulford and Larson;[71] Stockton;[84] Tomlinson and Bancroft.[89]

6. *Roentgenology.* Bowman;[8] Evans and Ball;[28] Lewin and Jenkinson;[49] Taylor.[86]

ETIOLOGY

The disease is produced by a specific fungus, *Oidium coccidioides.* While its ex-

* Read at the Thirty-First Annual Meeting, American Roentgen Ray Society, West Baden, Ind., Sept. 23–26, 1930.

act classification may be in question, its morphology, life cycle and cultural characteristics have been demonstrated to a degree that positive diagnosis has been available since the description of Ophüls and Moffit,[65] in 1900.

The adult form in animal tissues is a spherule, 15 to 40 microns in diameter. It has a refractile double-contoured capsule and granular protoplasm. Numerous minute endospores are formed and released by rupture of the capsule into the tissues. These develop by direct growth to new adult spherules.

The spherule in suitable culture medium develops into long septate hyphae producing a mycelium. In variable time endospores develop in the terminal segments of the hyphae.

The spores may reproduce the organism, either in mycelial form in culture or as spherules in animal tissues. Mycelia do not develop in animal tissues.

Spores spread the infection. Ahlfeldt, by special staining methods, demonstrated the spores in tissues showing no evidence of involvement grossly or microscopically. This is in keeping with the fact that the organism could be cultivated from such tissues.

She commented, "It took ten days for the animals to manifest any clinical symptoms. During the present morphologic study it was found that ten days was required for spore formation. Thus it would seem that spore formation is coincident with the spread of the disease."[3]

The organism grows well on common culture media, the rapidity depending upon temperature, the optimum being 37° C. It is distinguished from blastomycetes by method of multiplication in tissue. The *Oidium coccidioides* employs endosporulation; the blastomycetes, budding. Other pathogenic molds and yeasts are readily distinguished by microscopic and cultural characteristics.

The mode of infection has been studied experimentally. Ahlfeldt[2] succeeded in infecting animals through the abraded skin, by ingestion and through the respiratory tract. She concludes, "It is probable that coccidioidal granuloma may be transmitted through the skin as well as by the respiratory and gastro-intestinal tracts." Jacobson[44] failed to secure infection of animals by contact or by eating of infected food. He considers insect bite the usual means of inoculation, believing that a part of the life cycle of the organism is yet undiscovered in some insect. To support this he cites the fact that direct transmission of the disease from person to person has not been observed, despite excellent opportunity; also the fact that many of the patients through occupation and social status are liable to insect bite. The disease has been found in animals. However, the evidence does not favor transmission from animal to man. Two apparent transmissions of the disease to laboratory workers have occurred.

The general opinion now considers a primary pulmonary invasion most frequent. Ophüls favors this in his discussion of the paper of Evans and Ball.[28] Case histories apparently do not represent the proportion adequately. The initial pulmonary symptoms may subside and be lost sight of among other respiratory attacks.

Our own cases show only a small proportion of definitely proved primary pulmonary invasions. Early respiratory symptoms however, are common and an early chest film nearly always shows involvement. Therefore, our material may be said to support the belief that a primary or very early pulmonary invasion usually occurs.

The absence of gastrointestinal lesions speaks against frequent infection by that route.

Aside from pulmonary invasion the earliest recorded involvement includes a wide variety of cutaneous, subcutaneous, glandular and osseous lesions. In our cases these include lesions of foot and ankle, cervical region, hand, thorax, wrist, elbow, forearm, chin, knee and thigh. There were also a number of cases in which the first recorded symptom was multiple sites of pain.

Soil or soil products are considered the media of infection. Bump[14] demonstrated that the organism may live under most soil conditions. The hyphal spores are small, light and dry, and could readily be carried by dust. The occupations of a majority of the victims are those of free contact with soil or food products. Examples from our cases include ranchers, teamsters, fruit pickers, housewives, and laborers in general. A few children and adults having no especial soil contact are included. The predilection of sex in our cases is male, four to one, also explainable by soil contact. Age in our series varied from three months to sixty-four years. The general preponderance of adult involvement is also in keeping with this mode of infection. Race and nationality are not a factor except as explainable by occupational hazard. Mexicans, Filipinos and Negroes provide a high proportion of the victims.

Geographic Distribution. All of our cases but two appear to have arisen in California; one in New Mexico, one in Arizona. According to the epidemiologic survey of Cummins, Smith and Halliday,[22] approximately 80 per cent of the recorded cases are Californian in origin. Scattered cases have been reported from Washington, Arizona, New Mexico, Colorado, Kansas, Nebraska, Missouri, Illinois, South Carolina, Pennsylvania, Argentina and Brazil. Two hundred and eighteen cases have been reported to the California State Department of Public Health, as listed in its Bulletin of March 1, 1930.[91] Some, but not all, of our cases had their origin in the San Joaquin Valley.

The suspicion is almost universal with those who have studied the disease that there are many unrecognized cases both in California and throughout the country. Alertness to the disease may reveal that it is more prevalent than is now evident. However, the disease has been known to pathologists for many years. If it is prevalent to any considerable degree outside of California more cases should be coming to report.

PATHOLOGY

The pathology is well described by Ophüls[64]—"submiliary, miliary or larger nodules which resemble tubercles very closely. These nodules may caseate. Later the caseous material may liquefy and cavities containing pus-like material may be produced in this way, or in other cases there may be suppuration from the beginning, sometimes of a rather acute type, but usually of a more chronic character, leading to the formation of miliary, or larger, sometimes very large (size of an infant's head) chronic abscess or ulcers. The lesions are nearly always progressive, with marked tendency to dissemination by lymph and blood stream, still sometimes they may heal eventually."

Cutaneous involvement may occur as nodes or papular eruptions with or without ulceration and as evacuating sinuses of deeper abscesses. Abscesses may occur in the subcutaneous tissues. Lymph glands may be involved early and extensively with caseation and suppuration. The cervical glands are involved with especial frequency, with development of abscesses along the sternomastoid muscle and draining sinuses in the skin. Mediastinal and retroperitoneal glands may be the site of abscesses, often large.

In the lungs may be found extensive miliary lesions, nodular consolidations with caseation, abscesses or massive consolidations. These are prone to be confluent aggregations of tubercles but may be partly exudative in character. Miliary tubercles and local abscesses are frequent in various viscera, especially the liver, spleen and kidney. The gastrointestinal tract is notably free of lesions. A basal miliary meningitis is frequent in the fulminating type and in the terminal disseminated stage of the chronic cases. Occasional involvement of the spinal cord is seen. Our series includes one involvement of a fallopian tube, apparently primary.

The lesions of bone are essentially a destructive osteomyelitis, arising either centrally, subperiostally or by extension from

adjacent abscesses. Involvement of joints appears not to arise frequently except by extension from adjacent lesions.

Histologically the disease is a granuloma and the reaction to the infection a cellular tubercle, strikingly like that of tuberculosis. As in other granulomata there is central ischemia, with a tendency to caseation and liquefaction. The disease therefore has points of resemblance to the rather long list of granulomatous diseases. The common ones include tuberculosis, syphilis, blastomycosis, actinomycosis and glanders. Less common ones include sporotrichosis, streptothricosis, torulosis, moniliasis, granuloma inguinale and madura foot.

Like syphilis, actinomycosis and blastomycosis, it may infect through broken skin. Like tuberculosis, torulosis, moniliasis and streptothricosis, the primary invasion may be pulmonary. It has the tendency shared by others to chronic abscess with repeated partial healing and relapse. It shares the tendency of some to final fatal systemic spread from a localized focus. It is more prone to systemic dissemination than blastomycosis and sporotrichosis. In abscesses the granulomatous nature of the involvement may be disguised.

The organism may be found in pus and involved tissues. It may be recovered by culture or animal inoculation.

TREATMENT

Treatment is unsatisfactory on the whole. A few apparent cures have been reported from amputation of a part showing local involvement.

Various measures have been tried in the disseminated forms. Iodides, intravenous administration of thymol, mercurochrome and dyes have proved unsatisfactory. Intravenous and intramuscular medication by heavy metals such as colloidal lead, colloidal copper, potassium and antimony tartrate has had variable success. Colloidal copper has been employed in our hospital in a total of 17 cases. The results may be studied from the reports of Jacobson.[40,42,43] He feels that this remedy, though not ideal, has produced good results. Radiation therapy has been tried with indifferent results. Guy and Jacob,[30] and Tomlinson and Bancroft,[89] have reported apparent cures by combined intravenous antimony and roentgen therapy applied to local lesions. Guy, in discussion of the report of Chipman and Templeton,[18] infers an effect not secured from either measure alone. He quotes Goldthwaite as securing similar effects upon the *Entamoeba histolytica*. One of our cases reported by Hammack and Lacey[31] was recorded as improved after receiving arsenic and roentgen therapy. The combination of radiotherapy and heavy metal therapy appears to merit further trial.

The acute progressive generalized cases do not respond to any method of treatment.

CLINICAL MANIFESTATIONS

The clinical manifestations vary greatly with mode of infection and location of metastatic lesions. Frequently the onset is a respiratory attack described as "pneumonia", "influenza" or "tuberculosis", followed in a few weeks by rheumatic pains, adenopathy, abscesses and lesions of bone or skin. There are usually cough, sputum, fever, malaise, and occasionally hemoptysis. The disease may run a rapid course, advanced pulmonary involvement leading to death before somatic lesions become prominent, frequently with evidence of meningeal involvement.

If the pulmonary symptoms subside or the primary invasion is in the skin, the disease may be chronic. It may remain localized for weeks, months, or years. Amputation at this time may give apparent cure. There may be gradual dissemination with multiple lesions in skin, lymph glands, cutaneous tissues, bones, and lungs. Eventually there is severe toxic prostration and death.

DIAGNOSIS

Positive diagnosis rests upon the finding of the organism by the pathologist. The organism has been found after repeated fu-

tile search. In absence, however, of this proof the diagnosis cannot be made. Alertness and early provisional diagnosis are desirable by any who may encounter the disease in order that the pathologist may have opportunity to make a positive diagnosis.

The dermatologist will encounter cutaneous manifestations; the orthopedist, lesions of bone and joint; the neurologist, involvement of meninges and spinal cord. Those dealing with tuberculosis especially need be on guard because of the tuberculosis-like course of the rapidly progressive form. In all cases pulmonary symptoms add to the suspicion.

In our 55 cases only 5 were without roentgen examination and these due to lack of opportunity. All but one roentgenographed showed some manifestation of the disease. Thus it appears that the roentgenologist will encounter more cases than anyone except the pathologist. If there are criteria permitting a provisional diagnosis or even a legitimate suspicion of the disease, the roentgenologist may aid in diagnosis.

Those who have studied the disease have usually stressed its likeness to tuberculosis roentgenographically as well as otherwise.

Bowman,[8] in 1919, made the first roentgen study from the first 5 of our cases. He stressed its similarity to tuberculosis and commented on the presence of proliferative periostitis. Taylor[86] reported on 11 later cases in 1923. He emphasized the rapid evolution of the lesions and periosteal reaction as suspicious. Evans and Ball[28] made a brief roentgenographic summary in their analysis of our cases, saying "the roentgenologist may be in position to suggest the disease." Lewin and Jenkinson[49] in a paper on bone disease in childhood described lesions of a case, finding nothing characteristic.

For several years we have suggested the disease on certain evidence which the present survey is undertaken to test.

The roentgen-ray lesions are of three main types: soft tissue, osseous and pulmonary. Localized soft tissue swellings are frequently seen independent of bone lesions. These are usually localized and rather dense on the film. They indicate little except by association with other involvements.

LESIONS OF BONE

The survey reveals 94 lesions in 50 cases roentgenographed. Involvement arose in a region of cancellous bone, except one in the medullary canal of a humerus. Thirty were superficial in origin, either subperiosteal or extending from adjacent abscess. Twenty-seven arose centrally in spongiosa. The origin was not determinable in the remainder. Thus the origin is central or peripheral in the region of cancellous bone. With one exception involvement of the shaft or medullary region was seen only by extension.

Diaphyses were involved in 50 cases, epiphyses in 28, in the remainder both. The epiphyseal line was crossed in 25 cases, uninvolved in 13. Thus lesions may arise in either epiphysis or cancellous diaphysis. The tendency to be halted by an epiphyseal line is not prominent except in one location later described.

The degree of destruction within the lesion was complete in 53, partial in 40, the latter suggesting permeation.

Margins of involvement were circumscribed in 40, diffuse in 50.

Involvement is predominantly but not purely destructive. Bone production was shown only in a minority, marginal in 28, within the lesion in 14. Early or acute lesions tend to partial destruction, diffuse borders, no bone production and little or no periostitis. The chronic lesions tend to complete circumscribed central destruction, some bone production and a variable periostitis.

Only a few lesions of bone showed evidence of material healing. One carpal lesion showed complete excavation of involved bone with normal bone covered by thin cortex at its margins. Others showed partial repair with focal sclerosis like those of chronic osteomyelitis. Bone production predominated over destruction in a few cases.

The lesions appeared solitary in 74 per cent, in the remainder focal or doubtful.

Adjacent joints appeared involved in 28 cases locally and by extension. In 10 they appeared uninvolved. In only 2 they appeared involved selectively. This seems to afford a differentiation from tuberculosis in which the joint is involved early and selectively.

Associated soft tissue swelling was present in about half (46), varying from slight to marked, usually occurring in the cases of superficial origin or in advanced lesions. This swelling was usually localized and quite dense on the film, in keeping with the local abscesses of this disease. It appeared to differ from the diffuse edema or cellulitis of osteomyelitis and the fusiform swelling of tuberculous arthritis.

Atrophy of disuse or of bone adjacent to involvement was not pronounced except in a few lesions of wrist and ankle.

Disregarding blastomycosis, the most frequent simulation was tuberculosis (27). Twenty-two were listed as simulations of neoplasm, such as metastasis or myeloma. These were principally central lesions of spongiosa. A few were listed as simulating lues, periostitis, infectious arthritis, sarcoma and bone cyst.

The lesions were surveyed for bones involved and sites of involvement within them as follows:

Clavicle: 4 lesions, at medial and lateral extremities.

Scapula: 5, at the inferior angles, tips of acromion and coracoid processes and the vertebral border.

Humerus: 3, two at the condyles and one central medullary lesion.

Ulna: 6, three at the olecranon process, one at the styloid process and two in spongiosa.

Radius: 2, at the styloid process.

Femur: 1, at the lesser trochanter.

Patella: 4, three arising at the upper and lower poles and one in spongiosa (Fig. 1).

Tuberosity of the tibia: 8. This was the second most frequent location. This has an origin and evolution not believed to occur in any other disease and considered to be almost pathognomonic of coccidioidal granuloma. It arises subperiostally at the tuberosity and enlarges by direct extension crossing the epiphyseal line of the tuberosity readily, whether united or not. It involves in the advanced stage the full diameter of the bone but with no tendency to cross to the upper epiphysis of the tibia whether united or not. In only one of the 8 cases was extension into the adjacent knee-joint shown. Periosteal reaction varied from none in the early cases to marked in the advanced. There was one small involvement in the spongiosa of the tibia near the tuberosity (Fig. 2).

Malleoli of tibia and fibula: 9, arising superficially at the tips or superficial surfaces of bone, enlarging by direct extension, involving the joint late and locally and showing a variable marginal periostitis. The lack of bone repair appears to differentiate them from osteomyelitis. The late and limited involvement of the joint appears inconsistent with either osteomyelitis or tuberculosis (Fig. 3).

These lesions appear to form a group with a combination of location and character not common with any other known disease excepting blastomycosis. Thirty-eight lesions (40 per cent of the series) involve a group of bony prominences, the majority epiphyseal and superficial and showing a tendency to spare adjacent joints (Fig. 4).

Skull: circular punched-out areas of complete destruction involving the outer table and arising superficially. This corresponds with the autopsy record of 3 others of our cases and the case of Proescher, Ryan and Krueger.[69] It appears distinguished from osteomyelitis by the lack of serpiginous extension; from lues, myeloma and metastasis by its location (Fig. 5).

Ribs: 11, the most numerous of a single bone. Eight arose either at upper or lower margin and produced a semicircular extension into the bone. Three were central. Thus the majority of rib involvements differs from tuberculosis, metastasis or myeloma which are usually central in origin. They appear to differ from osteomyelitis in

FIG. 1. Origins at poles and in spongiosa of the patella. One involvement of the upper margin of a tibia anteriorly. Joint involved late and by extension.

Fig. 2. Origin at tuberosity of the tibia. Upper epiphysis spared, that of the tuberosity not. Articular cartilage uninvolved usually.

Fig. 3. Origin at surfaces of malleoli. Joint involved late and locally.

Fig. 4. Miscellaneous bony prominences, involvements of joints incidental.

Fig. 5. Circumscribed origin superficial, outer table first involved. Similar appearance inferred from description of blastomycosis.

remaining localized and purely destructive (Fig. 6).

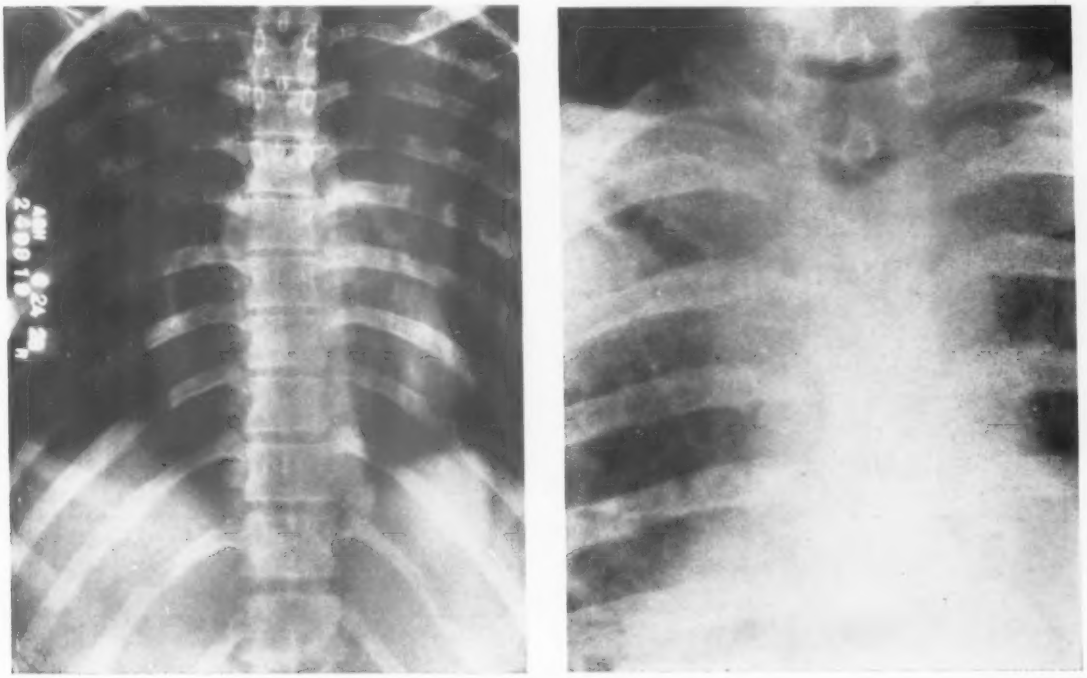
Sternum: 2, by extension.

Vertebrae: 6 involvements of the transverse processes, 5 of the bodies, 3 of the neural arches and one of a spinous process. The involvements of vertebral bodies were superficial erosions and localized central lesions not productive and most like metastatic neoplasm or myeloma. One compression associated with angular kyphosis and paravertebral abscess gave the classical appearance of tuberculosis (Fig. 7).

Pelvis: 3, one arising at the upper border of a superior pubic ramus, one at the ischium at its obturator margin. Both of these resembled the marginal lesions of ribs. The third consisted of multiple circular lesions in the iliac bones, resembling those of neoplasm or multiple myeloma (Fig. 8).

Carpus: 3, one of the triquetrium, two involving the whole carpus.

Tarsus: 9, two involving the astragalus, three the os calcis, one the cuboid and three multiple.



(*a*) (*b*)

Fig. 6. Ribs. Predilection to marginal involvement (*a*). A few central in origin (*b*). Obvious miliary involvement at the apex shown in the original film (*b*).

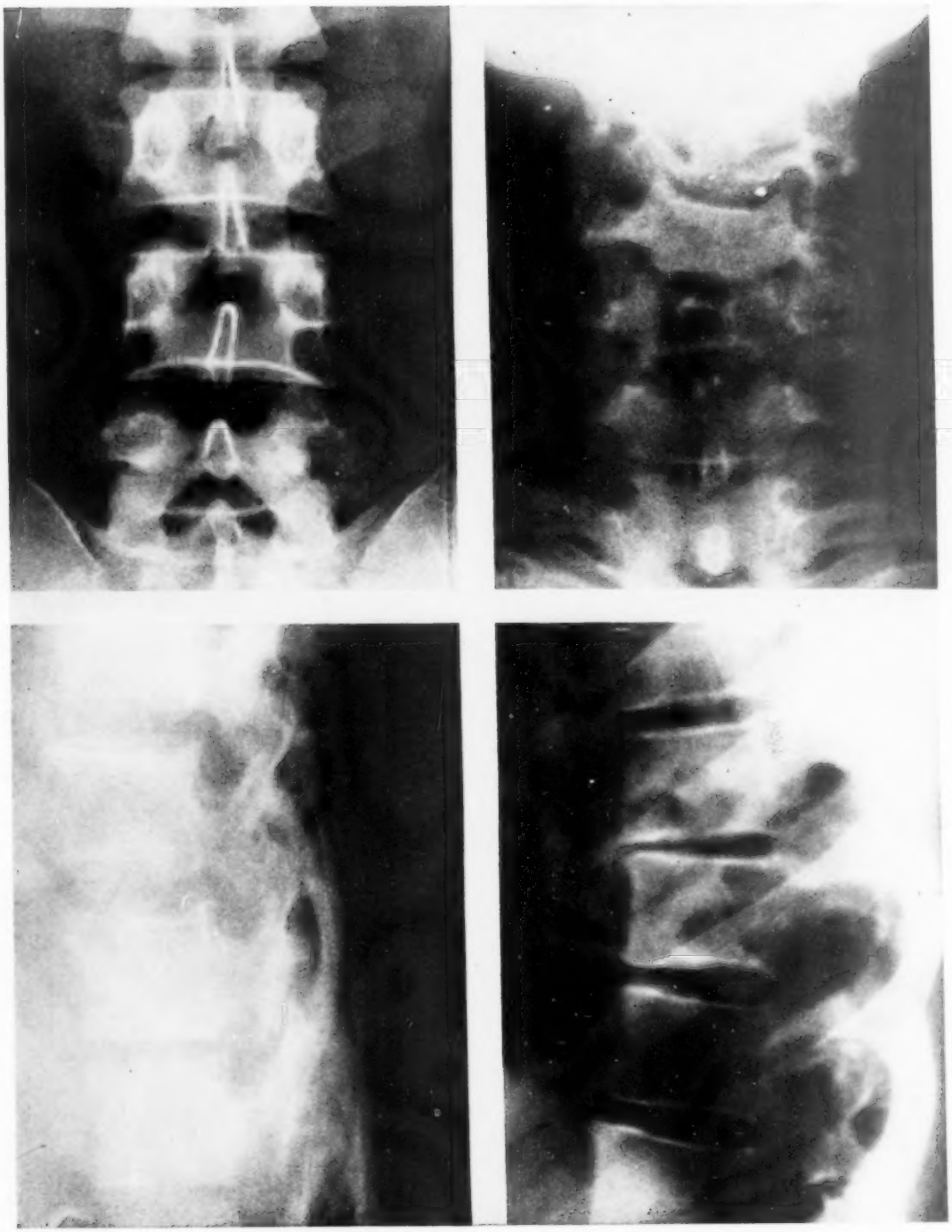


Fig. 7. Bodies, processes and neural arches involved. No collapse of the bodies usually.

The carpal and tarsal involvements have much soft tissue swelling, diffuse bone destruction and debatable sparing of cartilage. The lesions simulate tuberculosis or

Fig. 8. Multiple central lesions in iliac bones.

osteomyelitis with infectious arthritis. In these two regions there appears to be little characteristic of the disease (Fig. 9).

Metacarpal and phalangeal involvements: 6, most closely resembling osteomyelitis, acute or chronic. Some showed an exaggerated periostitis of the type seen in dactylitis of tuberculosis, lues or osteomyelitis (Fig. 10).

This series is not large enough to include all possible lesions. However, it is believed that characteristics and predilections are shown which will permit a provisional diagnosis in some cases.

Lesions directly suggestive of coccidioidal granuloma include:

1. Those arising at such bony points of prominence as poles of the patella, acromion or coracoid processes or angles of the scapula, olecranon or styloid processes of the ulna, styloid process of the radius, condyles of the humerus, extremities of the clavicles.

2. Lesions of malleoli as described.

3. Lesions arising at the tuberosity of the tibia, as described.

4. Marginal solitary lesions of ribs.

5. Localized destructive lesions of the outer table of the skull.

6. Destructive lesions of vertebrae attacking indiscriminately body, processes or neural arches.

There is great similarity to tuberculosis. Both have solitary lesions of spongiosa, are predominantly destructive, show little tendency to heal by bone production and are frequently associated with pulmonary involvement.

Coccidioidal granuloma is usually more rapid in onset and development. If chronic, it has definitely more periostitis and bone production. There is less atrophy of adjacent bone, apparently due to its more rapid course and shorter preceding period of disuse. Coccidioidal granuloma attacks a series of bony prominences not frequently involved in tuberculosis. While both are frequently situated at the spine, ankle, knee and ribs, the details of involvement differ. Tuberculosis attacks the joint selectively; coccidioidal granuloma, incidentally and by extension. Coccidioidal granuloma is more frequently multiple and more prone to be associated with cutaneous lesions, pulmonary involvement, adenopathy and abscesses in the soft tissues independent of bone. Tuberculosis is predominantly a disease of early life; coccidioidal granuloma of adult life.

Syphilitic osteomyelitis of cancellous bone and coccidioidal osteomyelitis may be identical in appearance. Both may have associated periostitis. Coccidioidal granuloma is usually more rapid, its clinical symptoms more marked, periostitis is less common and usually less extensive. Involvement of the shaft is rare except by extension. Extensive periostitis not associated with osteomyelitis seldom occurs. Bone production is seldom pronounced. The common sabre shin of lues has no counterpart in coccidioidal granuloma.

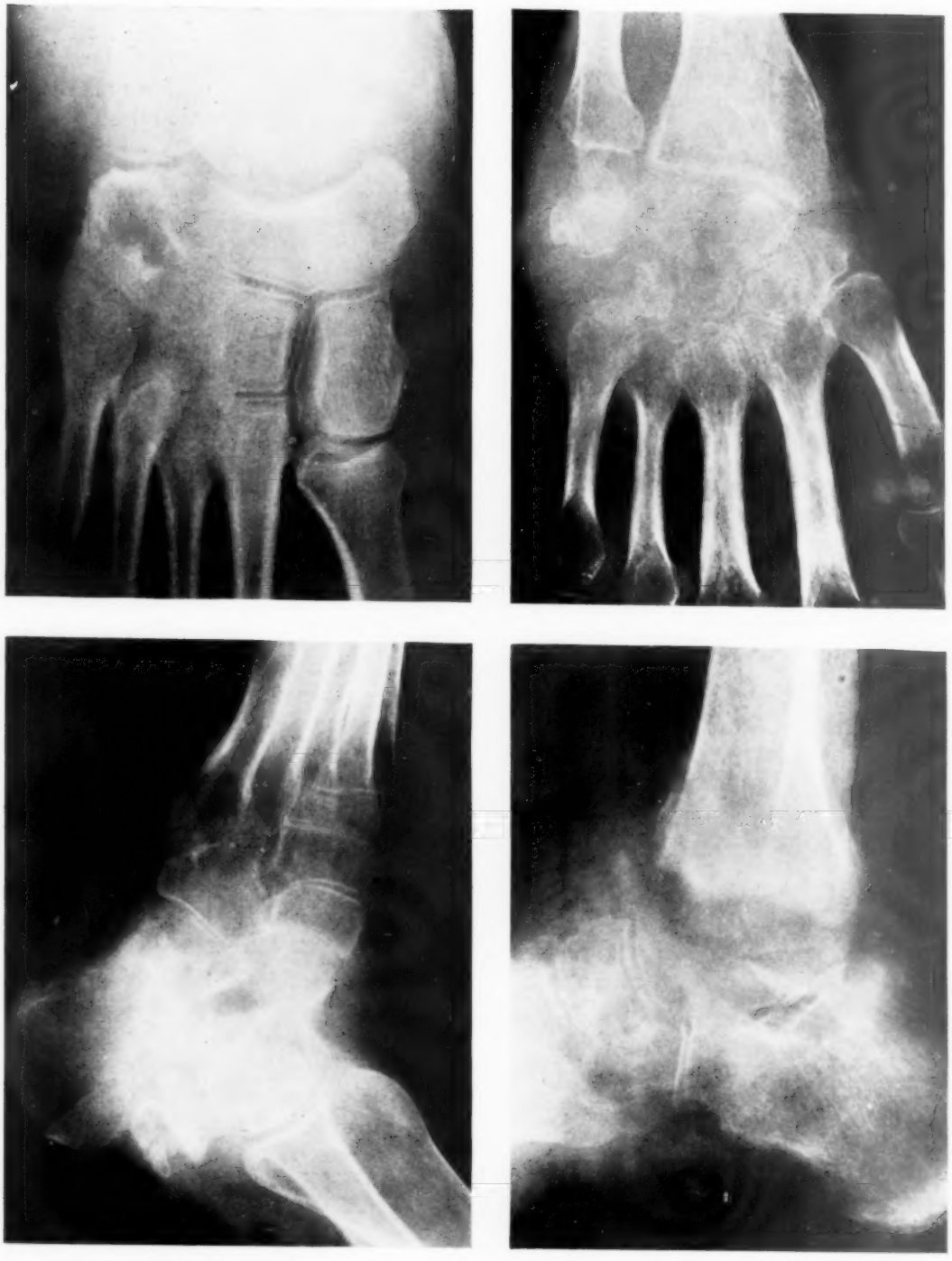


Fig. 9. Simulates tuberculosis or infectious arthritis, depending on bone production present.

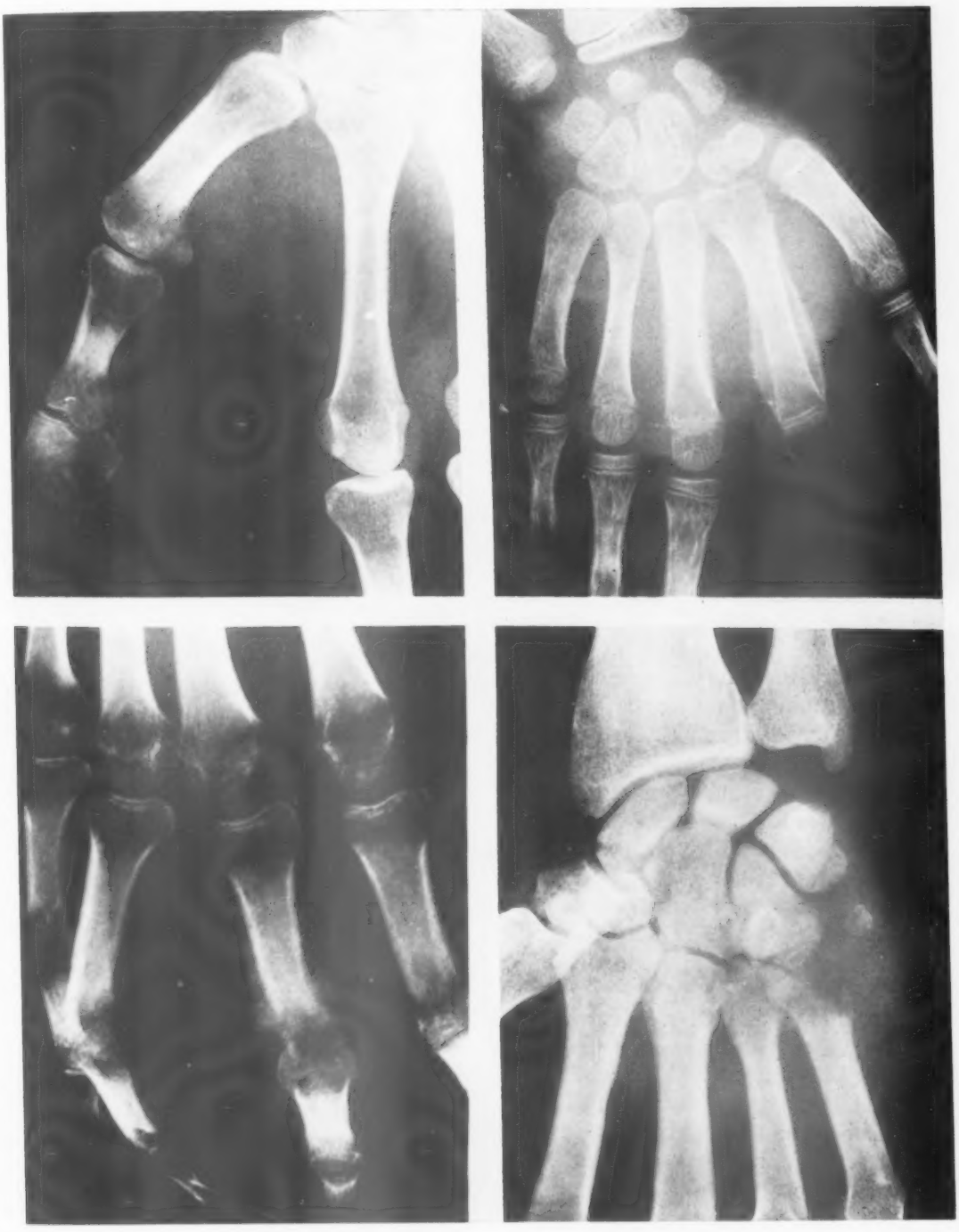


Fig. 10. Metacarpals and phalanges. Osteomyelitis simulated, also the dactylitis of osteomyelitis, lues or tuberculosis.

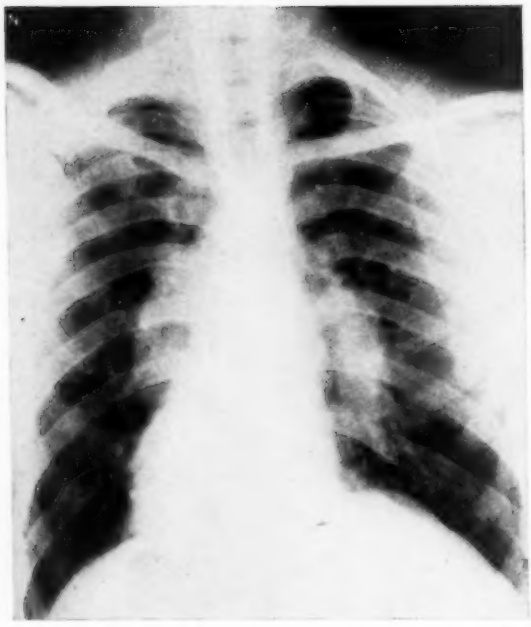


Fig. 11. Hilar thickening usually present in some degree.

Compared with metastases or multiple myeloma, certain central involvements of coccidioidal granuloma may resemble either. However, other more characteristic lesions will usually be present.

There are points of resemblance to osteomyelitis. Both may produce solitary or focal destructive lesions in spongy bone. Both may show bone production or periostitis. Coccidioidal granuloma is usually less rapid. It remains more localized, has distinctly less bone production and periostitis. It does not involve the shaft or produce widespread focal involvement but enlarges gradually from an original focus. It is more prone to multiple scattered lesions. It does not produce massive sequestration of large sections of bone and involucrum. It may simulate Brodie's abscess or a localized acute or chronic osteomyelitis and infectious arthritis with osteomyelitis.

Coccidioidal granuloma produces an involvement of carpal and metacarpal bones closely resembling the dactylitis of tuberculosis, lues and osteomyelitis.

Comparison with osseous lesions of blastomycosis must be made tentatively from the literature, particularly the descriptions of Hollis E. Potter.[83] Both are localized destructive lesions, solitary or focal, central or peripheral in origin, electing spongy bone. They have variable bone production and periostitis, they involve joints secondarily and seldom involve shafts of long bones. They are more prone to be multiple than those of tuberculosis. Even individual bones and regions of them involved are similar.

Potter's points of distinction made in discussion of Bowman's report of 1919 appear valid—less apparent liquefaction necrosis in the subepiphyseal regions, less pronounced and more ragged periosteal reaction, and more changes shown in the joints affected. If any of these may be modified it would be the point of periostitis. Some of our later cases have advanced, well-organized periostitis resembling closely Potter's description of blastomycosis.

Our coccidioidal lesions of the cranial vault conform closely to those described by Churchill and Stober[19] and by Myers and Stober.[62] Our lesions of the spine resemble

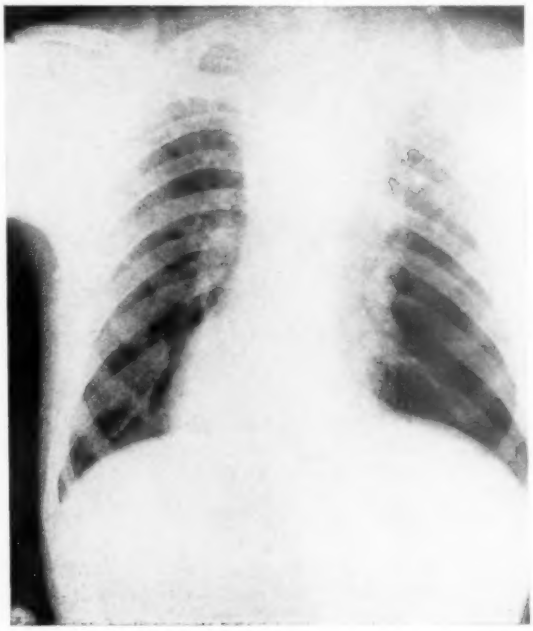


Fig. 12. Obvious mediastinal mass common.

closely those described for blastomycosis and actinomycosis.[66]

No comparison can be made at this time with other rarer granulomata of bone. The very close similarity of coccidioidal granuloma and blastomycosis and their general resemblance to tuberculosis lead to the inference that still others may have similar characteristics.

INTRATHORACIC INVOLVEMENT

Of 37 cases whose chests were roentgenographed, all but one showed involvement. Two others had early negative and later positive films.

Miliary lesions were evident in 19 (approximately half), not evident or doubtful in the remainder. Judging from autopsy reports, miliary pulmonary involvement is almost universal if the lung is involved at all. It was therefore probably present, demonstrated or not, in practically all of our cases. The miliary lesions appear more obscure on the film than in the average pulmonary tuberculosis. No convincing pathologic explanation for this fact is yet available. The miliary involvement was usually general and with localized accentuations of the process in some portion of the lung, most frequently on the right side (Fig. 6).

Fig. 13. Parenchymatous infiltration distinct from miliary dissemination usually present.

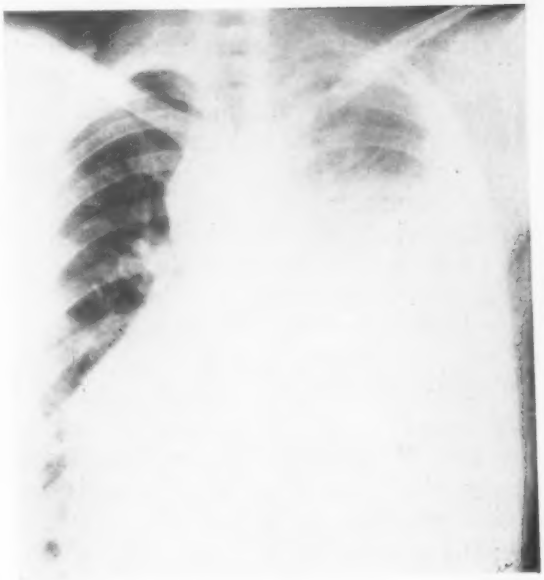


Fig. 14. Pleural involvement occasional, fluid, plastic, fibrous or by extension from adjacent abscess in the thoracic wall.

Hilar thickening was evident in 31 cases (80 per cent). This was diffuse, variable in degree but usually marked. It was unilateral or bilateral with a right-sided predominance (Fig. 11).

Definite mediastinal mass was evident in 17 cases (about half). In most cases the right mediastinal border was broadest (Fig. 12).

Parenchymatous infiltration, distinct from miliary dissemination, was present in 32 cases (90 per cent). This varied from slight clouding of exudative appearance to extensive dense consolidations. These latter were usually described at autopsy as confluent nodular or miliary involvement rather than a true pneumonic exudate (Fig. 13).

There was little evidence on the films of fibrosis. The little seen one is tempted to attribute to tuberculosis. However, healing by fibrosis is described at autopsy. A notable instance is the case of Dickson.[24]

Several cases showed pleural involvement (Fig. 14). Four had general effusion or empyema; one a localized plastic or fibrous

pleuritis without evidence of previous fluid. One showed local pleural extension from adjacent involvement of the thoracic wall.

Two small air-containing cavities were seen in upper lobes. Others were shown at autopsy apparently obscured on the films by fluid contents.

It is obvious that practically all of these films are compatible with a diagnosis of tuberculosis. This is natural since both tuberculosis and coccidioidal granuloma produce granulomatous lesions of lungs.

The outstanding features of coccidioidal chests are the high incidence of mediastinal involvement, miliary lesions and hilar thickenings, the lesser evidence of fibrosis and cavitation, and the general softness and vagueness of the lesions. Some of the hazy parenchymatous infiltrations must be considered to be exudative, congestive or pneumonic because of a tendency to disappear or shift in location.

The advanced lesions resemble the caseous or pneumonic types of tuberculosis, but with less tendency to cavitation. This latter is noteworthy in view of the marked tendency of coccidioidal granuloma to abscess formation elsewhere.

The pulmonary involvements conform to a type, however, not seen in a majority of cases of tuberculosis. A suggestive combination is presented when this type of tuberculosis-like involvement is associated with various extra-pulmonary conditions, as:

1. Lesions of bones as previously described.
2. Adenopathy.
3. Cutaneous lesions, such as sinus, ulcer, papular, nodular or verrucous growths.
4. Soft tissue masses or abscess.
5. Vague wandering rheumatic pains.

It is of assistance that coccidioidal lesions of the lung develop at times with a rapidity not seen in tuberculosis so that within two weeks marked advancement may be seen.

The combination is made more suspicious by persistent failure to find the tubercle bacillus. Even the finding of the bacillus does not exclude coccidioidal granuloma, as was proved in 3 of our cases.

The pulmonary lesions of coccidioidal granuloma are seldom seen alone, but nearly always associated with some other of the involvements mentioned. Granting that neither alone may be distinctive, it is believed that the combination at times creates a strong presumption of coccidioidal granuloma. This is particularly true in a region known to be infested and in patients with appropriate nationalities and occupations. For example: the diagnosis was made in a Mexican from a typical pulmonary involvement associated with a destructive lesion of the inferior angle of the scapula.

How far this could be carried outside of California where only sporadic cases are recorded is difficult to say. Doubtless the diagnosis would be suggested many times unsupported. However, if it is worth while for roentgenologists in other sections to be on guard against the disease, the diagnostic opportunity will most frequently be this: a pulmonary lesion associated with extra-pulmonary involvements as listed above, especially lesions of bones.

This is particularly true in recent years when roentgen examination, particularly of the chest, is more freely used. The earlier cases tended to present multiple lesions of bone without examination of the chest. In the more recent ones the pulmonary findings are more prominent. This is probably because the more acute cases with primary pulmonary invasion are now being recognized, whereas previously they were passed as acute pulmonary tuberculosis. In these the extra-pulmonary lesions may go undiscovered unless one is on guard.

Blastomycosis of the lung resembles tuberculosis or coccidioidal granuloma very closely and it is not probable that a positive distinction between them can be made. Blastomycosis may be expected to show a higher incidence of fibrosis, massive consolidation and pleural involvement, and a lower incidence of mediastinal adenopathy and miliary lesions than coccidioidal granuloma. The one film in our file shows apparent descending dissemination more typical

Fig. 15. Blastomycosis showing a descending extension not usual in coccidioidal granuloma.

of tuberculosis than of coccidioidal granuloma (Fig. 15).

Other rarer granulomata may well have pulmonary and extra-pulmonary lesions resembling these two. Our hospital, like others, has its list of granulomata, origin undetermined, with various combinations of lesions. Some may be tuberculosis, lues, coccidioidal granuloma or blastomycosis. Some may be rarer known granulomata. Some may well be diseases whose organism is yet unknown.

SUMMARY

1. Coccidioidal granuloma is roentgenographically similar to tuberculosis.

2. Features of pulmonary and osseous involvement will in some cases permit a provisional diagnosis between them.

3. The association of pulmonary and extra-pulmonary lesions in some cases is suggestive.

4. The roentgenologist may thus promote recognition of the disease although he cannot make a positive diagnosis.

5. The resemblance to blastomycosis is greater than to tuberculosis and distinction would seem difficult, if not impossible.

6. In viewing films of osteomyelitis of bone and tuberculosis-like lesions of lungs, the possibility of coccidioidal granuloma, blastomycosis and other infectious granuloma may be considered.

7. The frequent occurrence of infectious granulomata of undetermined origin suggests a field of future study.

REFERENCES

1. de Area Leao, A. E. Evolution du Coccidioides immitis dans les milieux vaccinés. Formation de substances activantes de la croissance dans les milieux de culture du Coccidioides immitis. *Compt. rend. Soc. de biol.*, 1928, *99*, 883–884.
2. Ahlfeldt, F. E. Studies in coccidioidal granuloma; mode of infection. *Arch. Path. & Lab. Med.*, 1926, *2*, 206–216.
3. Ahlfeldt, F. E. Special observations on morphology of Coccidioides immitis. *J. Infect. Dis.*, 1929, *44*, 277–281.
4. Bechtel, R. E., and LeCount, E. R. A case of systemic blastomycosis with necropsy. *Arch. Int. Med.*, 1914, *13*, 609–613.
5. Boughton, T. H., and Clark, S. N. A case of blastomycosis. *Arch. Int. Med.*, 1914, *13*, 594–598.
6. Boughton, T. H., and Stober, A. M. A case of systemic blastomycosis with recovery. *Arch. Int. Med.*, 1914, *13*, 599–606.
7. Bowles, F. H. Coccidioidal granuloma, report of the nineteenth case in California. *J. Am. M. Ass.*, 1912, *59*, 2253–2254.
8. Bowman, W. B. Coccidioidal granuloma. Am. J. Roentgenol., 1919, *6*, 547–555.
9. Brown, P. K. Report of the 17th and 18th cases of coccidioidal granuloma. *Calif. State J. M.*, 1906, *4*, 324–326.
10. Brown, P. K. Coccidioidal granuloma; review of the eighteen cases and reports of cases fifteen and sixteen. *J. Am. M. Ass.*, 1907, *48*, 743–746.
11. Brown, P. K. A fatal case of coccidioidal granuloma. *J. Am. M. Ass.*, 1913, *61*, 770–771.
12. Brown, P. K., and Cummins, W. T. A differential study of coccidioidal granuloma and blastomycosis. I. Pathology and bacteriology. II. Report of two additional cases of coccidioidal disease. *Arch. Int. Med.*, 1915, *15*, 608–627.
13. Burgess, J. F. Coccidioidal granuloma; report of case. *Brit. J. Dermat.*, 1929, *41*, 145–148.

14. Bump, W. S. Growth of Coccidioides immitis. *J. Infect. Dis.*, 1925, *36*, 561–565.
15. Burkhead, C. R. Oidiomycosis—including one case of coccidioidal granuloma and one of cutaneous blastomycosis. *J. Kansas M. Soc.*, 1922, *22*, 101–103.
16. Carson, G. R., and Cummins, W. T. A case of coccidioidal granuloma (California disease). *J. Am. M. Ass.*, 1913, *61*, 191–192.
17. Chipman, E. D. The newer cutaneous mycoses. *J. Am. M. Ass.*, 1913, *61*, 407–412.
18. Chipman, E. D., and Templeton, H. J. Coccidioidal granuloma. *Arch. Dermat. & Syph.*, 1930, *21*, 259–278.
19. Churchill, T., and Stober, A. M. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 568–574.
20. Cooke, J. V. Immunity tests in coccidioidal granuloma. *Arch. Int. Med.*, 1915, *15*, 479–486.
21. Cummins, W. T., and Sanders, J. The pathology, bacteriology, and serology of coccidioidal granuloma, with a report of two additional cases. *J. Med. Research*, 1916–1917, *35*, 243–257.
22. Cummins, W. T., Smith, J. K., and Halliday, C. H. Coccidioidal granuloma; epidemiologic survey, with a report of 24 additional cases. *J. Am. M. Ass.*, 1929, *93*, 1046–1049.
23. Davis, D. J. Coccidioidal granuloma; with certain serologic and experimental observations. *Arch. Dermat. & Syph.*, 1924, *9*, 577–588.
24. Dickson, E. C. Oidiomycosis in California, with especial reference to coccidioidal granuloma, including nine new cases of coccidioidal granuloma and one of systemic blastomycosis. *Arch. Int. Med.*, 1915, *16*, 1028–1044.
25. Eisentaedt, J. S., and Boughton, T. H. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 617–620.
26. Editorial. Coccidioidal granuloma. Am. J. Roentgenol. & Rad. Therapy, 1929, *22*, 471–472.
27. Evans, N. Coccidioidal granuloma and blastomycosis in the central nervous system. *J. Infect. Dis.*, 1909, *6*, 523–536.
28. Evans, N., and Ball, H. A. Coccidioidal granuloma; analysis of 50 cases. *J. Am. M. Ass.*, 1929, *93*, 1881–1885.
29. Gardner, S. J., and Halton. An unusual infection in the bones of the foot. *Calif. State J. M.*, 1904, *2*, 386–388.
30. Guy, W. H., and Jacob, F. M. Granuloma Coccidioides. *Arch. Dermat. & Syph.*, 1927, *16*, 308–311.
31. Hammack, R. W., and Lacey, J. M. Coccidioidal granuloma in Southern California. *Calif. & West. Med.*, 1924, *22*, 224–226.
32. Hektoen, L. Systemic blastomycosis and coccidioidal granuloma. *J. Am. M. Ass.*, 1907, *49*, 1071–1077.
33. Helsley, G. F. Coccidioidal granuloma, report of case. *J. Am. M. Ass.*, 1919, *73*, 1697–1698.
34. Hirsch, E. F. Introduction of coccidioidal granuloma into Chicago. *J. Am. M. Ass.*, 1923, *81*, 375–377.
35. Hirsch, E. F., and D'Andrea, D. Sensitization of guinea-pigs with broth culture filtrates and with killed mycelium of Coccidioides immitis. *J. Infect. Dis.*, 1927, *40*, 638–640.
36. Hirsch, E. F., and D'Andrea, D. Specific substance of Coccidioides immitis. *J. Infect. Dis.*, 1927, *40*, 634–637.
37. Hirsch, E. F., and Benson, H. Specific skin and testis reactions with culture filtrates of Coccidioides immitis. *J. Infect. Dis.*, 1927, *40*, 629–633.
38. Hirsch, E. F., and Coleman, G. H. Acute miliary torulosis of the lungs. *J. Am. M. Ass.*, 1929, *92*, 437–438.
39. Jackson, H. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 607–608.
40. Jacobson, H. P. Granuloma coccidioides; apparently successfully treated with colloidal copper; report of two cases. *Calif. & West. Med.*. 1927, *27*, 360–364.
41. Jacobson, H. P. Coccidioidal granuloma; specific allergic cutaneous reaction; experimental and clinical investigations. *Arch. Dermat. & Syph.*, 1928, *18*, 562–567.
42. Jacobson, H. P. Coccidioidal granuloma. *Calif. & West. Med.*, 1928, *29*, 392–396.
43. Jacobson, H. P. Coccidioidal granuloma; further observations with report of 7 additional cases. *M. J. & Rec.*, 1929, *130*, 424–428; 498–499.
44. Jacobson, H. P. Coccidioidal granuloma; a clinical and experimental review with case reports. *Arch. Dermat. & Syph.*, 1930, *21*, 790–817.
45. Kalichman, G. S., and Madsen, L. J. Coccidioidal granuloma; report of case. *Calif. & West. Med.*, 1929, *31*, 141–142.
46. Kelton, W. Coccidioidal granuloma. *Northwest. Med.*, 1927, *26*, 92–93.
47. Krost, R. A., Stober, A. M., and Moes, M. J. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 557–567.
48. Lemon, W. S. Clinical manifestations of coccidioidal granuloma. *Proc. Staff Meet., Mayo Clinic*, 1929, *4*, 305–306.
49. Lewin, P., and Jenkinson, E. L. Bone diseases in infancy and childhood. Am. J. Roentgenol. & Rad. Therapy, 1927, *17*, 201–214; abridged in *Radiology*, 1927, *8*, 409–415.
50. Lewison, M., and Jackson, H. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 575–584.

51. Lipsitz, S. T. Systemic blastomycosis and coccidioidal granuloma with a description of the first case of coccidioidal granuloma reported in Missouri. *J. Missouri M. Ass.*, 1916, *13*, 534–536.

52. Lipsitz, S. T., Lawson, G. W., and Fessenden, E. M. A case of coccidioidal granuloma. *J. Am. M. Ass.*, 1916, *66*, 1365–1367.

53. Lynch, K. M. Coccidioidal granuloma, including the first reported case east of Mississippi. *South. M. J.*, 1920, *13*, 246–249.

54. MacNeal, W. J., and Hjelm, C. E. Note on a mold, Coccidioides immitis, found in a case of generalized infection in man. *J. Am. M. Ass.*, 1913, *61*, 2044.

55. MacNeal, W. J., and Taylor, R. M. Coccidioides immitis and coccidioidal granuloma. *J. Med. Research*, 1914, *30*, 261–274.

56. Montenegro, J. Septicemia from Coccidioides immitis. *Brazil-med.*, 1925, *1*, 69–70.

57. Montgomery, D. W. A disease caused by a fungus, the protozoic dermatitis of Rixford and Gilchrist. *Brit. J. Dermat.*, 1900, *12*, 343.

58. Montgomery, D. W., and Morrow, H. Reasons for considering dermatitis coccidioides an independent disease. *J. Cutan. Dis. incl. Syph.*, 1904, *22*, 368–375.

59. Montgomery, F. H., and Ormsby, O. S. Systemic blastomycosis; its etiologic, pathologic and clinical features as established by a critical survey and summary of twenty-two cases, seven previously unpublished; the relation of blastomycosis to coccidioidal granuloma. *Arch. Int. Med.*, 1908, *2*, 1–41.

60. Montgomery, D. W., Ryfkogel, H. A. L., and Morrow, H. Dermatitis coccidioides. *J. Cutan. Dis. incl. Syph.*, 1903, *21*, 5–10.

61. Morris, M. Coccidioides of the central nervous system. *Calif. & West. Med.*, 1924, *22*, 483–485.

62. Myers, H. J., and Stober, A. M. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 585–593.

63. Ophüls, W. Further observations on a pathogenic mould formerly described as a protozoon (Coccidioides immitis, Coccidioides pyogenes). *J. Exper. Med.*, 1905, *6*, 443–486.

64. Ophüls, W. Coccidioidal granuloma. *J. Am. M. Ass.*, 1905, *45*, 1291–1296.

65. Ophüls, W., and Moffit, H. C. A new pathogenic mold (formerly described as a protozoon; Coccidioides immitis pyogenes). *Phila. M. J.*, 1900, *5*, 1471–1472.

66. Parker, C. A. Actinomycosis and blastomycosis of the spine. *J. Bone & Joint Surg.*, 1923, *5*, 759–777.

67. Posadas, A. Psorospermiose infectante généralisée. *Rev. de chir.*, 1900, *20*, 277–282.

68. Powers, C. A. Ref. by MacNeal and Taylor (ref. 55).

69. Proescher, F., Ryan, F., and Krueger, A. P. Case of coccidioidal granuloma with autopsy findings. *J. Lab. & Clin. Med.*, 1926, *12*, 57–70.

70. Pruett, J. F., and Wayson, N. E. Granuloma coccidioides, note on disease with report of case. *J. Am. M. Ass.*, 1923, *81*, 1607–1609.

71. Pulford, D. S., and Larson, E. E. Coccidioidal granuloma; report of case treated by intravenous dye, colloidal lead and colloidal copper, with autopsy observations. *J. Am. M. Ass.*, 1929, *93*, 1049–1055.

72. Ragle, H. E. Coccidioidal granuloma with report of case. *U. S. Nav. M. Bull.*, 1929, *27*, 657–661.

73. Rand, C. W. Coccidioidal granuloma; report of two cases simulating tumor of the spinal cord. *Arch. Neurol. & Psychiat.*, 1930, *23*, 502–511.

74. Riesman, D., and Ahlfeldt, F. E. Coccidioidal granuloma; review of clinical data with report of a Pennsylvania case. *Am. J. M. Sc.*, 1927, *174*, 151–167.

75. Riley, F. B., and LeCount, E. R. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 614–616.

76. Rixford, E. Case of protozoic dermatitis. *Occidental M. Times*, 1894, *8*, 704–707.

77. Rixford, E., and Gilchrist, T. C. Two cases of protozoan (coccidioidal) infection of the skin. *Johns Hopkins Hosp. Rep.*, 1896, *1*, 209–265.

78. Roblee, W. W. Report of a case of oidiomycosis. *Calif. State J. M.*, 1914, *12*, 387–389.

79. Ryfkogel, H. A. L. Coccidioidal meningitis. *J. Am. M. Ass.*, 1910, *55*, 1730–1732.

80. Seilin, J. Report of a case of dermatitis coccidiosa. *Med. Rec.*, 1919, *95*, 360–361.

81. Shaffner, P. F. A case of systemic blastomycosis. *Arch. Int. Med.*, 1914, *13*, 621–623.

82. Stark, N. A., and Becker, F. E. Report of a case of coccidioidal granuloma. *Colorado Med.*, 1928, *25*, 196–202.

83. Stober, A. M. Systemic blastomycosis; a report of its pathological, bacteriological and clinical features. *Arch. Int. Med.*, 1914, *13*, 509–556.

84. Stockton, A. B. Coccidioidal granuloma; treatment with thymol; report of case. *Calif. & West. Med.*, 1929, *31*, 278–280.

85. Stokes, W. R., Kiser, E. F., and Smith, W. H. Bronchomycosis; report of two cases. *J. Am. M. Ass.*, 1930, *95*, 14–18.

86. Taylor, R. G. Coccidioidal granuloma. Am. J. Roentgenol., 1923, *10*, 551–558.

87. Thorne, W. S. A case of protozoic skin disease. *Occidental M. Times*, 1894, *8*, 703–704.

88. Tomlinson, C. C. Granuloma coccidioides. *M. Clin. North America*, 1928, *12*, 457–462.

89. Tomlinson, C. C., and Bancroft, P. Granuloma coccidioides; report of case responding favorably to antimony and potassium tartrate. *J. Am. M. Ass.*, 1928, *91*, 947–951.

90. Walters, P. R. Coccidioidal granuloma; case report. *Calif. & West. Med.*, 1928, *29*, 188–189.

91. *Weekly Bulletin, California State Dept. of Health.* Coccidioidal granuloma widely distributed., March 1, 1930, *9*, 4–15.

92. Wernicke, R. Ueber einen Protozoenbefund bei Mycosis fungoides (?) *Centralbl. f. Bakteriol.*, 1892, *12*, 859–861.

93. Wolbach, S. B. The life cycle of the organism of "dermatitis coccidioides." *J. Med. Research*, 1904–1905, *13*, 53–60.

94. Wolbach, S. B. Recovery from coccidioidal granuloma. *Boston M. & S. J.*, 1915, *172*, 94–96.

DISCUSSION

Dr. H. K. Pancoast, Philadelphia. We are all very much indebted to Dr. Carter for this excellent presentation of the various lesions of this most unusual condition. I know of no other one condition that resembles so many others as this one, and it is a most difficult problem, or practically an impossible one, to classify the various lesions.

The organism, the *Oidium coccidioides*, produces only endospores in the tissues and not the budding that is found in blastomycosis. I have had the opportunity to study one case of this kind which was rather different from any that has been shown. This case was a boy who spent a summer in Arizona and then went to Los Angeles to have his tonsils removed. He then came back to Philadelphia with glandular enlargements in his neck which were regarded as tuberculous and for which we treated him. He did not respond in any way and as is our custom, we insisted on having a biopsy, and we were very much surprised to find the endospores present, both intracellular and extracellular. These slides were most interesting. The small, rounded, highly refractile bodies in hyperplastic tissues, made one almost believe there must be some parasitic cause of cancer. The entrance in this boy was probably in the oral pharynx. One or the other tonsil may have been infected and was removed as the seat of the disease, when it was thought to be merely a hypertrophied tonsil. At any rate, the enlargement appeared later in the neck. He died within a few months despite treatment, without evidence of any lesions in the chest or bones. Abscesses occurred through the body.

The bone lesions in this condition, as you have noted, look like various other conditions, especially tuberculosis, and especially syphilis with the periosteal proliferations. Chronic infective osteomyelitis and metastatic carcinoma are also simulated.

I looked over all of Dr. Carter's illustrations and many of the cases I certainly would have diagnosed as one of the conditions which I have named. It is impossible to make a diagnosis of coccidioidal granuloma unless one is dealing with a number of cases of this kind and is living in the neighborhood where they are prevalent and has some very good reason for suspecting the condition.

It behooves us to remember the possibilities of such a condition being present because we now know that all the cases that have occurred have not come from the San Joaquin Valley. They are found in various parts of this country, though many of them have been traced to an origin in California.

In the chest, there are very few lung conditions that I can recall offhand that are not simulated very closely by this condition. Certainly pulmonary tuberculosis, blastomycosis and syphilis, if there is such a thing as pulmonary syphilis, and last, but not least, pneumoconiosis.

The treatment is more or less successful, as Dr. Carter stated. As he very aptly states in his paper, in cases that rapidly become general, treatment is of no avail. That was the case with our patient. The iodides and the roentgen treatment had no effect whatever.

Dr. W. Edward Chamberlain, San Francisco. Perhaps one has to be from California to thoroughly appreciate a paper like Dr. Carter's, because in California coccidioidal granuloma is a serious problem. Hardly a day goes by without the necessity of at least considering it in the differential diagnosis of chest or skeletal conditions.

Coccidioidal granuloma is a dreadful disease. Its relative incurability and its severe and uncomfortable manifestations are in themselves very disturbing, and additional cause for dread arises from the mysterious way in which it crops up, most unexpectedly. Until recently, we considered the mortality in this disease to be practically 100 per cent, regardless of what organs or parts might be involved. It now appears that

the mortality is not so high, and the following two recent cases suggest that infection with this organism may be followed by spontaneous recovery in a fair number of cases. I suspect that cases occur with rapid recovery, without the identification of the organism.

In California this disease is spoken of as "the San Joaquin Valley disease," although it is by no means confined to that portion of the State.

A year or so ago, a man reported to the Stanford Chest Clinic with lung disease which was soon identified as coccidioidal granuloma. He had been working as a teamster in the San Joaquin Valley, and we considered it possible that the fungus was carried into his lungs in the dust which envelopes every San Joaquin Valley teamster during most of his hours of labor.

The roentgenogram in this case was fairly typical of tuberculosis, but exhibited more enlargement of hilar glands than is usual with tuberculosis, and showed, furthermore, a distribution of lung tissue infiltration which was somewhat unusual for tuberculosis. The coccidioidal organism was identified in the sputum, which was negative for tubercle bacilli.

This patient recovered, completely, and we were able to follow his recovery with serial roentgenograms which showed very strikingly the clearing up of the infiltrations and consolidations and hilar tumefactions.

A year ago a Stanford medical student, working on this disease in Dr. Dickson's bacteriological laboratory, opened a test tube containing an old dried culture of coccidioides on agar. He had been warned against opening an old dried culture, because this organism, which looks so different in the tissues, becomes a fungus or mould on culture media, and grows aerial hyphae which float in the atmosphere.

This medical student noticed the floating away of some of the fuzz from the mould, realized his mistake, quickly closed the tube, and wondered whether he might not have gotten some of it into his respiratory tract. Ten days later he was taken ill with malaise, fever. He rapidly lost weight, and two weeks later a chest examination was made, with negative physical findings. A roentgenogram at this time showed a roentgen appearance exactly like that of a rapidly advancing tuberculosis. The right upper lobe exhibited, in its caudal third, a typical miliary affair, stopping at the interlobar septum. The left upper lobe exhibited a similar patch in its caudal sixth.

Without hesitation, we diagnosed tuberculosis and began to study the sputum. No tubercle bacilli could be found, but there were huge numbers of the coccidioidal organism. Cultures as well as smears were positive. We still have the cultures and there is no question about the diagnosis. The organism was recovered several times from his sputum.

No one expected to see the boy get well. He developed an erythema nodosum about the fourth or fifth week, which made us think of fluctuating subcutaneous abscesses, such as these cases frequently develop, and when that quieted down and the boy began to get well, we were agreeably surprised, but somewhat hard to convince. However, he made a complete recovery, and for more than eight months now we have been unable to find any signs, either by roentgenography or by any other method of examination.

I am sure Dr. Carter could have shown you some pictures of the bizarre and unusual skin lesions that we see in this disease. We have a patient whom we have followed for twelve years, with coccidioidal granuloma of the skin of his foot. The foot is of huge size, with a very large verrucous surface, a horrible looking thing. We have advised him over a period of twelve years to have an amputation, but he will not agree to it. We feel sure that, ultimately, the disease will spread to other parts of his body. Why it has persisted in one area and has shown no signs of extension to other parts in this particular case is a little hard to understand.

Dr. Alfred L. Gray, Richmond, Va. I think if we are on the lookout for this condition, we will find it isn't by any means confined to the San Joaquin Valley.

About eighteen months ago a young man was referred to me, a clerk about thirty years of age. He had been treated for granulomatous lesions on his ankles and wrists. Needless for me to say, it was of no material benefit, treating of course by local applications. I recognized at once that it was some form of parasitic or fungoid lesion of the skin and referred him to our laboratory for culture and biopsy. I thought it was a case of blastomycosis and was amazed to receive a report of coccidioidal granuloma. This young man was treated with the iodides and with local irradiation and he very promptly recovered. He showed no evidence whatever of bone involvement or chest involvement. It has now been more than a year since he was dis-

charged. I have heard nothing further from him since. I am sure he would have come back had he had a recurrence.

DR. CARTER (closing). I thank Dr. Pancoast, Dr. Chamberlain and Dr. Gray for their discussions. I will simply add this: In the last few years the character of involvements seen has been changing. Formerly they were usually advanced cases with multiple bone lesions; now we see more obscure pulmonary involvements associated with some extrathoracic condition, sometimes very minor; for instance, a small papillomatous node on the face or a slight adenopathy. There is often rapid onset and early death. I do not believe this means change in the disease, but the recognition of cases previously going unrecognized as rapid tuberculosis.

One point, the organism is sometimes difficult to find, and we cannot exclude the disease on the strength of one or two negative laboratory reports. The culture seems drowned frequently by a heavy staphylococcus contamination and the organism is sometimes discovered after repeated negative examinations.

Vol. XXV, No. 6

OSTEITIS FIBROSA CYSTICA GENERALISATA WITH HYPERPARATHYROIDISM AS ETIOLOGY*

By RICHARD DRESSER, M.D., *and* A. O. HAMPTON, M.D.

BOSTON, MASSACHUSETTS

THE diagnosis of osteitis fibrosa cystica is usually established by roentgenographic examination and is a condition with which the roentgenologist should be thoroughly familiar. The localized type will not be discussed in this paper. There is, however, a generalized osteitis fibrosa cystica associated with hyperactivity of the parathyroid glands which is less commonly seen and which in the well-developed stage produces a characteristic roentgen picture. This generalized type, of which we shall report two cases, involves not only bones of the extremities but produces extensive changes in the skull, spine, ribs, and pelvis.

SYMPTOMS AND ETIOLOGY

The disease is seen most commonly between the ages of thirty and sixty, although cases have been reported in younger individuals. Women are more frequently affected than men. Pain, muscular weakness, and postural abnormalities are common symptoms. Medical advice is often first sought because of a spontaneous fracture. There may be loss of weight which is not apparent until the patient is placed on the scales, since the loss is due to decalcification of the bones and is not the result of soft tissue wasting. There is often constipation, anorexia, and occasionally attacks of abdominal pain and vomiting. There may be evidence of cardiac insufficiency.

These patients invariably show a disturbance of calcium metabolism. The blood serum calcium is elevated (more than 10 mg. per 100 c.c.) and the serum inorganic phosphorus is low (less than 4 mg. per 100 c.c.). The urine shows an increase in both calcium and phosphorus content. The increased elimination of calcium causes polyuria and frequency. The large amount of lime salts in the urine leads to the formation of kidney stones which are frequently bilateral. Pyonephrosis may be a complicating factor. If untreated the disease is slowly progressive. Paraplegia follows softening and mushrooming of the vertebral bodies with compression of the cord. When the ribs are extensively involved there may be a sinking in of the thoracic wall with embarrassment of cardiac and respiratory function. An intercurrent infection usually causes death.

The etiology of osteitis fibrosa cystica remained obscure until fairly recently. In 1907, Erdheim (quoted by Hoffheinz) reported on the frequency of enlargement of the parathyroid glands in cases of osteomalacia. He advanced the theory that this was a compensatory hypertrophy resulting from an increased burden on these glands. Hoffheinz in reviewing a series of 44 cases of enlarged parathyroid glands, with the addition of one case of his own, found 27 in which there was disease of the bones. Seventeen of these 27 cases were diagnosed as osteitis fibrosa cystica. In 1922, Morton, after an extensive review of the subject, offered the suggestion that there might be an abnormality of calcium metabolism in osteitis fibrosa cystica analogous to the abnormal carbohydrate metabolism of diabetes. He mentioned the possibility that the blood calcium might be higher than normal, which would occasion a loss of calcium in the urine. In 1926, Collip showed that the administration of parathyroid extract would relieve the symptoms of tetany produced by extirpation of the parathyroid glands. He also demonstrated an increase in the serum calcium of normal animals after giving parathyroid extract. The function of the parathyroid glands in the regulation of the concentration of blood calcium was thus proved.

* From the Departments of Roentgenology, Massachusetts General Hospital, Boston, and The Memorial Hospital, Worcester, Mass.

In 1926, Mandl, a Viennese surgeon, observed a case of generalized osteitis fibrosa cystica on which he decided to test Erdheim's theory. He reasoned that if the hypertrophy of the parathyroids were truly a compensatory mechanism then transplantation of normal parathyroid tissue should be of benefit. Successful transplantation had been accomplished by other surgeons in cases of paralysis agitans, working on the theory that this disease was the result of hypoparathyroidism. Mandl obtained four normal parathyroids from the moribund victim of an accident and transplanted these into the body of a thirty-eight year old man who was suffering from generalized osteitis fibrosa cystica. Contrary to expectations, there was no improvement whatsoever in the patient's condition. Mandl then concluded that Erdheim's hypothesis was wrong, and that he was dealing with a hyperfunction of the parathyroids produced by a tumor, analogous to the dysfunction produced by an hypophyseal tumor in cases of acromegaly. There was no palpatory evidence of a new growth, but the patient was willing to undergo any operation which might offer hope of improvement. The neck was explored and a small, yellowish-brown tumor measuring 25×15×12 mm. was found occupying the position of one of the parathyroids. This was successfully removed and proved histologically to be an adenoma. The patient immediately began to improve. His pain disappeared. The calcium content of the urine which had been 54 mg. per 100 c.c. before the operation dropped to 9.6 mg. The patient was soon able to get about on crutches, which had been impossible previous to the operation. Roentgenograms made four months after the extirpation of the tumor showed a considerable increase in the calcium content of the bones.

Since this classical report of Mandl's a number of cases of a similar nature have appeared in the literature which afford additional proof that adenoma of the parathyroid causing hyperfunction of the gland is an etiological factor in generalized osteitis fibrosa cystica (Beck; Boyd, Milgram and Stearns; Bulger, Dixon, Barr and Schregardus; Gold; Hunter; Snapper; Wilder).

PATHOLOGY

Most of the parathyroid tumors have been about the size of an almond. However, the tumor removed from one of our cases was unusually large, measuring 6.5 x 5 x 3 cm. These growths are well encapsulated, and on microscopic examination show an adenomatous structure which may be difficult to differentiate from normal parathyroid tissue. Degenerative changes within the tumor are frequently observed. Specimens removed from the cystic areas in the bones invariably present the histological picture of benign giant cell tumor (giant cell sarcoma); the multiplicity of the lesions, however, at once rules out this condition.

Hoffheinz gives an excellent gross pathological description of the bones. His case was that of a female, aged forty-two, who died in an advanced stage of generalized osteitis fibrosa cystica. The autopsy protocol is abstracted in part:

Skull. The vault of the skull is thickened throughout (the thickness varies between 6 and 9 mm). The skull cap is so flexible that the cut surfaces can be approximated. The surface of the bones is rough, with numerous very closely spaced, sharp pointed projections, between which are depressions varying in size from a pinhead to 2 or 3 mm. In addition to this, one sees on the surface several depressions as large as a quarter, in the region of which are found very pronounced osteophytic deposits. Similar changes are found on the inner surface of the calvarium. The sutures are plainly visible. The blood vessel grooves on the inner surface are deep. The bone in the middle and the posterior fossae of the base is, in the lateral portions, unusually thin so that it is translucent, and in some places simulates thick parchment. The color is in general a yellowish brown, but in addition there are numerous dark brown, irregularly spaced flecks varying in size from a pinhead to several millimeters. The bone is soft, and can be cut with a knife. This softening is not uniform, but is most pronounced over the larger dark brown areas. On the cut surface nor-

mal bone structure cannot be recognized. Neither the outer nor inner tables, nor the diploë are distinguishable. One sees a structure of fine bone trabeculae lying close together with pinhead sized depressions between so that the tissue on cross section appears spongy and in part motheaten.

Lumbar Vertebrae. The vertebrae are normal in size. They are soft and can be cut with a knife. On the cut surface one observes the following: The portion of the vertebral body lying adjacent to the intervertebral disc consists of a grayish, yellowish brown, fairly uniform, soft mass, in contrast to the darker brown portion, which corresponds to the central part of the body. The central portion presents a spongy bony structure with numerous closely spaced, little brown depressions varying in size from a pinhead to 2 or 3 mm. lying between the bony trabeculae. On section a brown fluid is expressed from these depressions. They are lacking in the portion of the vertebra which is adjacent to the intervertebral disc, and are also absent in the vertebral processes.

Extremity. The bone is on the whole not so soft as the skull and vertebral bodies, and the structure is less markedly altered. In the shaft the differentiation between compact and spongy substance can still be clearly made out. In the middle of the shaft is a multilocular cavity, the outer bony covering of which is 1 or 2 mm. thick. This cavity contains a yellowish-brown fluid and in its lower portion a crummy, dark brown mass, similar to bone marrow, which can be lifted out with a knife.

Fig. 1. Case I. Diffuse mottling and thickening of the bones of the vault.

ROENTGEN APPEARANCE

In the well-advanced stage of the disease the roentgen appearance is characteristic.

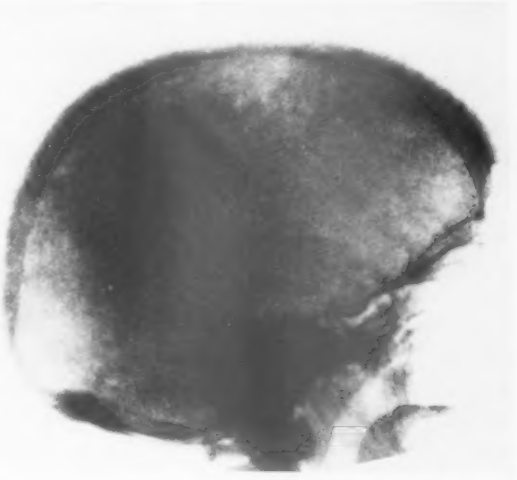


Fig. 2. Case II. The picture is identical with Figure 1, except that the process is more advanced.

Skull. The calvarium is thickened throughout. The films on our cases taken at a distance of 4 feet show an increase in thickness of from 0.5 to 1 cm. above the average. The inner and outer tables cannot be differentiated. The larger blood vessel grooves are fairly distinct. The diploë are not visualized. The bones of the vault present a generalized, finely mottled, granular texture, produced by closely spaced areas of diminished density which are irregular in outline and vary from a fraction of a millimeter to a centimeter or more in diameter. The intervening bone is more dense than normal (Figs. 1 and 2). The softening of the bones of the base causes flattening and diminution in depth of the fossae posterior to the sella turcica.

The accessory nasal sinuses and mastoids are not remarkable. The sella turcica is normal in size and outline. Cystic areas may occur in the maxilla and mandible. Loosening of the teeth with bone absorption about the roots has been reported. The

Fig. 3. Case II. Extensive cystic changes in the pelvis and femora, with fracture of the left ilium.

general appearance of the skull bears a slight resemblance to Paget's disease, but no difficulty should be experienced in differentiating the two conditions.

Vertebrae. The contour of the vertebrae may be normal or, as a result of the softening of the bone, there may be narrowing of the vertebral bodies with scoliosis and an increase in the normal anteroposterior curves of the spine. The intervertebral discs remain normal in width. The texture of the bone is considerably altered. The multiple minute cystic areas in the vertebral bodies cast shadows of diminished density on the film which produce a finely mottled appearance similar to that seen in the bones of the vault of the skull. The changes in the vertebral bodies, however, are of a more detailed character and may be entirely overlooked unless the roentgenographic technique is unusually good. We have not observed alteration of the vertebral processes, which is in accord with the pathological picture described by Hoffheinz.

Pelvis. The most extensive bony changes which the disease produces are often observed in the pelvis. There may be an extreme degree of decalcification with replacement of the normal bone structure by large, trabeculated, or non-trabeculated cystic areas, associated with some alteration in the general contour of the pelvis. As we should expect, slight trauma may result in a fracture (Fig. 3).

Ribs. There is generalized decalcification of the ribs, and occasional cystic areas associated with expansion and extreme thinning of the cortex.

Extremities. The long bones present well-defined cysts which are frequently trabeculated, and which may be located in any part of the diaphysis. There may be pronounced expansion of the cortex in association with these cystic areas, or the cortex may be merely thinned without appreciable expansion. There is no evidence of periosteal proliferation, and no soft tissue tumor (Fig. 4). Snapper has observed cysts in the metatarsals, and one of our cases showed them in the metacarpals (Fig. 5).

Spontaneous fractures are common and tend to unite readily, but excess of callus is not seen (Fig. 6). A cyst which has been the site of fracture may show a tendency toward healing, as evinced by generalized

Fig. 4. Case II. Bilateral trabeculated cysts of the tibia and fibula, with expansion and thinning of the cortex.

increase in density with loss of definition of outline (Fig. 5).

In addition to the cystic areas, there is generalized decalcification of the long bones manifested by thinning of the cortex and loss of density. Bowing of the lower extremities is noted in some instances.

In young individuals slipping of the epiphyses has been observed. Boyd et al, in reporting the case of a twenty-one year old male, describe bilateral slipping of the femoral head in relation to the shaft, a varus deformity of the ischium, and alteration of the normal angle of the head of the humerus in relation to the shaft. One of Duken's patients whose epiphyses had not yet united showed changes similar to those of late rickets.

Fig. 5. Case 1. Cysts of second and third metacarpals. Partial healing of cyst in the second metacarpal following spontaneous fracture.

Fig. 6. Case 1. Cyst of the ulna with spontaneous fracture and thinning without expansion of the cortex.

Roentgenograms of the abdomen frequently show renal calculi which are usually bilateral (Fig. 7). Pyelography may reveal an associated hydronephrosis (Fig. 8).

The disease in its early stages may present less extensive changes than those above described. In a case reported by Bulger et al, the patient, a thirty-eight year old male, showed a tumor occupying the position of the left upper canine and first and second bicuspid teeth, with extension into the hard palate posteriorly and beyond the alveolar margin anteriorly. The patient had first noticed the tumor eight months previously. Roentgen examination disclosed a smaller tumor of the opposite maxilla and three separate and distinct tumors of the lower jaw. Roentgenograms of the skull and long bones were negative. There were no urinary calculi. There was none of the general symptoms of hyperparathyroidism.

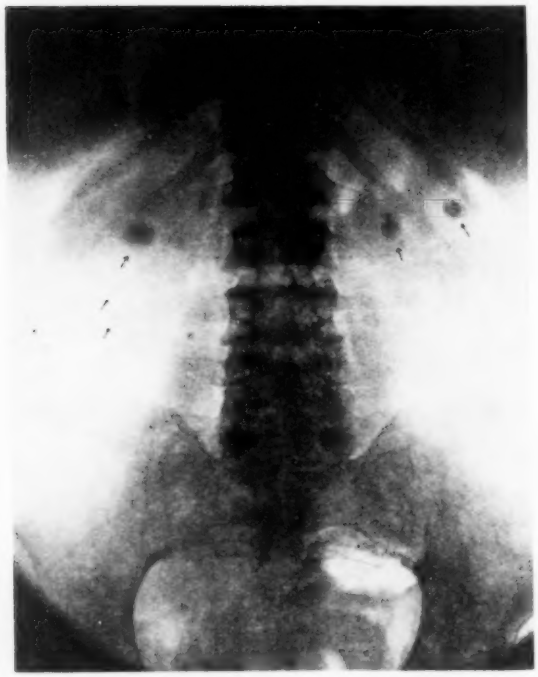


FIG. 7. Case II. Bilateral renal calculi.

FIG. 8. Case II. Bilateral hydronephrosis.

The tumors were treated by curettement and irradiation. Six weeks later, blood studies showed an elevated serum calcium and diminished phosphorus content. A more careful physical examination then showed a small swelling at the sternal end of the clavicle which proved at operation to be a parathyroid tumor.

TREATMENT

High voltage roentgen irradiation was given over the spine in one of our cases with the hope of relieving pain, but without success. It would seem reasonable to expect a reduction in the activity of the hyperfunctioning parathyroids following irradiation of the neck. We are instituting this form of therapy in Case II which presented no tumor at operation.

Bulger and his coworkers have observed that the administration of orthophosphate causes a decrease in serum calcium and an increase in serum phosphorus, with a reduction of calcium in the urine. This would indicate that clinical improvement might be expected in hyperparathyroidism following the administration of orthophosphate.

The only hope of permanent relief lies in removal of the parathyroid tumor. Even though the tumor cannot be palpated, if the patient presents the roentgen picture described and shows at the same time an elevation of calcium in the blood and urine with a decrease in the blood phosphorus, an exploratory operation is warranted. Mandl, in a subsequent paper, emphasizes the necessity of operative exposure of all the parathyroids. He states that the case is clearly one for extirpation when, in addition to the tumor, one also finds normal parathyroids. Beck's case is cited in which three parathyroids were removed, two of them containing adenomata. The blood calcium was lowered to such an extent that the fifth day after operation tetany developed and the patient died on the twentieth day. One must be sure that sufficient parathyroid tissue remains in the organism.

Immediately following the removal of the parathyroid tumor there is a tendency in most cases toward hypoparathyroidism,

the reverse of the preoperative condition. The symptoms, however, can usually be controlled by the administration of parathormone (parathyroid extract), together with a high calcium intake.

In certain cases presenting the clinical picture of hyperparathyroidism, no tumor has been found at operation and normal parathyroid tissue has been removed. Bauer, Albright and Aub report some clinical improvement in such a patient. However, one of the cases which we are reporting has received no benefit from the removal of two parathyroids which on histological examination proved to be normal. The extirpation of normal parathyroid tissue should, if possible, be avoided for should a tumor subsequently be found its removal might be impossible without the development of a fatal tetany. It may be noted that the superior parathyroids are often deeply embedded in the thyroid gland, and might well be involved by a tumor which would be technically impossible to locate at operation.

CASE REPORTS

Case 1. (Memorial No. 11616, Baker No. 1423). Female, aged forty-four, white, married, admitted to the Memorial Hospital, Worcester, Mass., September 26, 1930. The patient was referred for complete roentgenographic study by Dr. Charles E. Ayers and Dr. Harold F. Miller.

Her chief complaint was rheumatism with pain and swelling of the right forearm. She stated at one time that she had been perfectly well until a year previously, and at another time gave the history of slow loss of strength over a period of several years. Three years ago she had neuritis in the right arm which lasted about nine months. A little over a year ago she fell on the right hip with resulting lameness which lasted two or three months. Nine months ago she began having soreness and aching in the right side which has continued to the present time. About three months ago the same soreness appeared in the left thigh and is still present. Two weeks ago pain and swelling developed in the second metacarpal of the right hand. A week ago pain and swelling appeared in the midportion of the right forearm. For the past two months she has had slight dysuria and has noticed a strong odor to the urine. There has also been some frequency. Her best weight twenty-three years ago was 158 pounds. Two years ago it was 115 pounds. She weighs at present 95 pounds. She has been married twenty years and has two children living and well. There were two miscarriages after the two living children.

Fourteen years ago, following the second miscarriage, the patient first noticed a swelling in the region of the thyroid on the right side.

The salient points of the physical examination were as follows: The teeth were all missing. The tonsils were embedded, the left showing a whitish exudate. There was a small palpable gland in the right side of the neck just below the angle of the jaw. The thyroid showed some swelling of the isthmus and definite enlargement in the region of the right lobe. This enlargement was soft and uniform. The thorax was symmetrical. The lungs were resonant throughout. Examination of the heart was negative. The blood pressure was 118/80. The abdomen was negative to palpation. The extremities presented no edema or varicosities. Deep pressure on the shafts on both femora elicited tenderness. There was also pronounced tenderness on pressure over the right forearm.

Roentgen examination showed an extensive pathological process involving the skull, spine, ribs, pelvis and bones of the extremities. The lungs were clear. A flat film of the abdomen showed no evidence of urinary calculi. In the extremities the process was characterized by areas of destruction and cyst formation in both tibiae, both femora, the right ulna, and the second and third metacarpals of the right hand. In places the cortex of the bone was very much thinned and expanded. There was a spontaneous fracture of the right ulna, and there had apparently also been a fracture of the second right metacarpal with some filling in of the cystic area by new bone. Both innominate bones presented a cystic, trabeculated, destructive process. The ribs showed multiple small areas of destruction together with several cystic expansions. The skull and spine presented a diffuse, finely mottled appearance produced by small areas of destruction alternating with areas of increased bone density. The process was more pronounced in the skull than in the vertebrae.

The urine showed a specific gravity varying between 1.011 and 1.022; no albumin; no sugar; no Bence-Jones protein. Blood count: red blood

cells, 4,350,000; white blood cells, 5,800; polymorphonuclears, 56 per cent; lymphocytes, 40 per cent; transitionals, 4 per cent. Basal metabolic rate, 3+. Temperature normal.

On September 29, 1930, a biopsy was performed by Dr. Ayers. Through a small incision over the dorsum of the right ulna the bone was exposed. The cortex was friable. With a curette a part of the medullary portion of the bone was obtained for diagnosis. The bone seemed to be cystic and fibrotic. It lacked the normal bone structure.

The specimen was examined by Dr. William Elliott, and showed the microscopic picture of a benign giant cell tumor. A diagnosis of osteitis fibrosa cystica was made.

Blood calcium and phosphorus determinations were made by Dr. Oliver H. Stansfield. The serum calcium was found to be 11 mg. per 100 c.c. and the phosphorus 2.3 mg. per 100 c.c. The patient was given a total of 900 r, high voltage roentgen irradiation to two areas over the spine in the hope of alleviating pain but without result. At the request of Dr. Fuller Albright, she was then referred to the Massachusetts General Hospital for further metabolic studies. She was admitted on November 10, 1930. On November 12, the blood serum calcium was 13.7 mg. per 100 c.c. (normal, 10 mg. per 100 c.c.) and the phosphorus was 2.6 mg. per 100 c.c. (normal, 4 mg. per 100 c.c.). On a low calcium diet the urine calcium was 708.0 mg. in a three day period.

The patient was operated on, December 10, 1930 by Dr. Richard H. Miller: Usual thyroid incision, infrahyoid muscles clamped and cut. The right lobe of the thyroid was pushed forward by what seemed to be a tumor lying behind it. This tumor was smooth, intimately connected with the right lobe, about the size of a very small tangerine. There was a groove which showed a dividing line between the thyroid itself and the underlying tumor. At the time it was impossible to state whether this was a groove arising from back of the thyroid gland or whether it was a line of demarcation of the parathyroid tumor. The whole tumor, together with the right lobe of the thyroid, was removed without difficulty and all bleeding points tied. The left lobe of the thyroid was not in any way remarkable and was not touched. The operation was uneventful. The wound was closed with skin tubes, one small rubber drain being inserted.

Ten days after operation the serum calcium was 10.1 mg. per 100 c.c. and the serum phosphorus was 3.35 mg. During a three day period on a low calcium diet following the operation the urine calcium was 27.0 mg. The patient began to show pronounced clinical improvement. Roentgenograms taken January 5, 1931, showed a slight but definite filling in of the cystic areas with new bone. The parathyroid tumor was examined by Dr. Tracy B. Mallory and Dr. H. K. Hartwell. The report is as follows: An ovoid mass measuring 6.5×5×3 cm., weighing 53 grams, composed of homogeneous pale, yellowish tissue. On section the structure is made up of closely grouped, uniform, polyhedral cells arranged in strands and closely simulating the appearance of normal parathyroid tissue. No evidence of malignancy. Diagnosis, benign tumor of the parathyroid gland (parathyroidoma).

Case II (M. G. H. No. 184237, Baker No. 7727). Female, aged forty-one, white, married, admitted to the Massachusetts General Hospital July 11, 1930.

Complaint, rheumatism. The present illness began five years ago following the birth of the fifth child. There was weakness in the back and knees, and pain in the knees on walking. About two months following delivery the pain became somewhat less, but never cleared up completely. Three years ago, during the eighth month of the sixth pregnancy, the pain and weakness in the knees became so pronounced that the patient had to use a cane for walking. Two years and ten months ago the patient was given shoes for fallen arches with some relief. At this time it was very difficult for her to go up and down stairs. Two and one-half years ago the patient had to resort to crutches. Two years ago the crutches slipped and the patient fell, suffering a fracture of the right hip. Seven months ago the patient again slipped and the sudden wrench in trying to save herself from falling resulted in a fracture of the right clavicle. Six and one-half months ago a sudden twist of the right arm resulted in a fracture of the upper third of the humerus. These fractures were cared for at another hospital, during which time she was confined to bed. Two months ago the patient began to get about a little, but complained bitterly of weakness and pain in the legs and back.

Physical examination showed an obese woman, teeth absent, lungs clear, heart enlarged to

the left, pulse forceful and rapid with a short systolic murmur at the apex. The blood pressure was 185/105. The right pupil was slightly larger than the left. Both were irregular and practically fixed to light. They reacted well to accommodation. There were no abnormal masses palpable in the region of the thyroid. The right knee jerk was active. The left was obtained with difficulty. The flexors of the right hand were very weak. The flexors of the right thigh were also weak. The left leg was slightly swollen and red. The left shin felt rough and nodular. All bones were tender on pressure, more especially the left tibia. The red blood cells numbered 3,060,000, the hemoglobin was 60 per cent, the white blood cells were 4,500, polymorphonuclears 64 per cent, lymphocytes 30 per cent, mononuclears 5 per cent, eosinophiles 1 per cent. The specific gravity of the urine varied between 1.010 and 1.020. There was a slight trace of albumin, no sugar, large numbers of white blood cells, but no casts. A fresh specimen was negative for Bence-Jones protein.

The blood serum calcium was elevated to 13.5 mg. per 100 c.c. and the blood phosphorus was 2.16 mg. per 100 c.c.

Roentgen examination included the entire skeleton, the chest, a flat film of the abdomen and a pyelogram. All the bones showed a generalized loss of calcium, characterized by thinning of the cortex and loss of density. The extremities showed cysts in the right humerus, the right clavicle, the left radius, the upper ends of both femora, and the mid-portions of both tibiae and fibulae. Several of the ribs showed the same cystic areas with pronounced expansion of the cortex. There was evidence of an old fracture of the right clavicle, of the surgical neck of the right humerus, and of the left ilium, and probably an old fracture of the intertrochanteric region of the right femur. There were extensive cysts in both innominate bones. The bones of the cranial vault showed a diffuse, finely mottled appearance characterized by multiple, small areas of diminished density separated by areas of greater density. The vertebrae presented much the same appearance as the skull. The abdominal films showed bilateral renal calculi, and a pyelogram revealed hydronephrosis.

The patient was operated on by Dr. Richard H. Miller on September 12, 1930, with a preliminary diagnosis of adenoma of the parathyroid. The thyroid gland was elevated from below upward and the lower two parathyroid glands were identified and removed. On pathological examination these glands showed the microscopic picture of normal parathyroid tissue. The recovery from the operation was uneventful.

There has been no appreciable change in the patient's general condition, and there has been no definite change in the blood serum calcium and phosphorus. Follow-up roentgen examination of the skeleton has shown no deposition of new bone. High voltage roentgen irradiation over the neck is to be instituted in this case.

SUMMARY

The symptoms, etiology, pathology, and treatment of generalized osteitis fibrosa cystica associated with over-activity of the parathyroid glands has been presented.

Roentgen findings have been described which are characteristic in the well-advanced stage of the disease.

A palpable tumor of the parathyroid has been present in a number of cases.

Even though a tumor cannot be palpated, if the patient presents the roentgen picture described and shows at the same time an elevation of calcium in the blood and urine with a decrease in blood phosphorus, an exploratory operation is warranted.

Remarkable clinical improvement follows the successful extirpation of a parathyroid tumor.

The removal of normal parathyroid tissue is to be avoided if possible.

The association of generalized osteitis fibrosa cystica with hyperparathyroidism was first brought to our attention by Dr. Fuller Albright and Dr. Walter Bauer. We are grateful to them for their assistance in the preparation of this article. The metabolic studies in the two cases cited will be reported in detail by Dr. Albright.

REFERENCES

1. Barr, D. P., Bulger, H. A., and Dixon, H. H. Hyperparathyroidism. *J. Am. M. Ass.*, 1929, *92*, 951–952.

2. Bauer, W., Albright, F., and Aub, J. C. A case of osteitis fibrosa cystica (osteomalacia?) with evidence of hyperactivity of the parathyroid

bodies. Metabolic study 2. *J. Clin. Investigation*, 1930, *8*, 229–248.
3. BECK, A. *Arch. f. klin. Chir.*, 1928, *152*, 123–124.
4. BOYD, J. D., MILGRAM, J. E., and STEARNS, G. Clinical hyperparathyroidism. *J. Am. M. Ass.*, 1929, *93*, 684–688.
5. BULGER, H. A., DIXON, H. H., BARR, D. P., and SHREGARDUS, O. The functional pathology of hyperparathyroidism. *J. Clin. Investigation*, 1930, *9*, 143–190. (See this article for more complete bibliography.)
6. COLLIP, J. B. The parathyroid glands. *Medicine*, 1926, *5*, 1–57.
7. DUKEN, J. Beitrag zur Kenntnis der malacischen Erkrankungen des kindlichen Skelettsystems; Spätrachitis und Osteodystrophia fibrosa. *Ztschr. f. Kinderh.*, 1928, *46*, 114–136.
8. GOLD, E. Ueber die Bedeutung der Epithelkörpervergrösserung bei der Ostitis fibrosa generalisata Recklinghausen. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1928, *41*, 63–82.
9. HOFFHEINZ. Über Vergrösserungen der Epithelkörperchen bei Ostitis fibrosa und verwandten Krankheitsbildern. *Virchow's Arch. f. path. Anat. (etc.)*, 1925, *256*, 705–735.
10. HUNTER, D. Hyperparathyroidism. (Hyperfunction of a parathyroid tumor in a case of generalized osteitis fibrosa.) *Proc. Roy. Soc. Med. (Sect. Med.)*, 1929, *23*, 27–34.
11. KIENBÖCK, R., and MARKOVITS, E. Ein Fall von Ostitis fibrosa cystica generalisata. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1930, *41*, 904–919.
12. MANDL, F. Klinisches und Experimentelles zur Frage der lokalisierten und generalisierten Ostitis fibrosa. *Arch. d. klin. Chir.*, 1926, *143*, 1–46.
13. MANDL, F. Therapeutischer Versuch bei einem Falle von Ostitis fibrosa generalisata mittels Exstirpation eines Epithelkörperchentumors. *Zentralbl. f. Chir.*, 1926, *53*, 260–264.
14. MANDL, F. Zur Frage der Exstirpation eines Epithelkörpertumors bei der allgemeinen Ostitis fibrosa. *Zentralbl. f. Chir.*, 1929, *56*, 1739–1745.
15. MORTON, J. J. The generalized type of Osteitis fibrosa cystica. *Arch. Surg.*, 1922, *4*, 534–566.
16. SNAPPER, I. Gezwel van een Bijschildklier en Skeletafwijkingen. *Nederl. tijdschr. v. geneesk.*, 1929, *2*, 4758–4773.
17. WILDER, R. M. Hyperparathyroidism; tumor of the parathyroid glands associated with osteitis fibrosa. *Endocrinology*, 1929, *13*, 231–244.

Vol. XXV, No. 6

KÜMMELL'S DISEASE

WITH REPORT OF A ROENTGENOLOGICALLY PROVED CASE*

By LEO G. RIGLER, M.D.

MINNEAPOLIS, MINNESOTA

WHEN, in 1895, Kümmell[9] first reported the disease entity which still bears his name, the roentgen examination of the spine was still unknown. As a result of his inability to provide visual proof of his thesis, some doubt was held as to the actual occurrence of the "rarefying osteitis of the vertebral body" secondary to trauma which he described. There is still some confusion and doubt as to the actual nature of the process, but the evidence on this score has been so well reviewed in recent papers[1,2,8,10] that it seems unnecessary to deal with it here in any detail. The most recent theory, expounded by Schmorl, has been referred to by Kümmell[11] and applied clinically by Geist.[5] Schmorl believes that an injury to the intervertebral disc causes a rupture with expansion of the nucleus pulposus and secondary atrophy of the body of the vertebrae. The various names which have been applied to this condition express fairly well the nature of the process. In addition to the first one (quoted above) given by Kümmell himself, there are "post-traumatic spondylitis," "post-traumatic vertebral collapse," "post-traumatic spondylomalacia," and many others. Essentially Kümmell meant to describe a compression of a vertebral body, occurring late after a mild trauma, and without any evidence of a true fracture. The prominent feature of the disease is the absence of marked symptoms or physical signs for some weeks after the injury is sustained. Later, evidences of compression of a vertebral body such as pain, weakness, neurological disturbances, gibbous formation and other abnormalities appear.

Although there have been relatively few case reports in this country, the Continental literature is replete with descriptions of this condition. Mauclaire and Burnier[12] consider it to be relatively common, while Osgood,[14] Steindler,[18] and other authorities believe that there is no doubt of the existence of this disease as a clinical entity. On the other hand, George and Leonard[6] express considerable doubt as to the occurrence of any such process as Kümmell described, and they suggest that many of these cases may be unrecognized fractures.

While some of the cases reported have eventually been shown to be non-traumatic in nature, such conditions as tuberculous spondylitis having been falsely diagnosed as Kümmell's disease, this is not the most serious doubt which is thrown upon the existence of this disease entity. The possibility that these cases are simply small fractures with delayed symptoms is a more important criticism of the whole theory. A careful perusal of the case reports indicates that this possibility has been insufficiently considered.

As our knowledge of spinal injuries has grown and roentgen examination has become more exact and more generally applied, we have realized more and more that a true compression fracture of a vertebral body, especially of the lower thoracic and lumbar segments, may occur without any striking symptoms or signs. I have repeatedly observed cases of back injury, without apparent disability or deformity, which on roentgen examination showed a moderate compression, without dislocation of one of the vertebrae. In such cases, if no treatment were instituted, the symptoms and signs might readily increase to the point of serious disability. Roberts[16] and Sever[17] have reported such cases, and the experience is not an uncommon one. That these are clearly not cases of Kümmell's disease seems obvious. Nevertheless, in this type of case, if roentgen examination were not made until some months after the injury, the find-

* From the Department of Roentgenology of the University of Minnesota and the University Hospital, Minneapolis, Minnesota.

ings might be strongly suggestive of this entity.

It seems highly probable that many of the cases reported as being post-traumatic spondylomalacia may rather be cases of fracture with delayed symptoms. If, however, good roentgenograms were made at the time of injury or shortly after and showed no evidence of fracture or other abnormality, and later roentgen examination revealed a compression of one or more of the vertebrae, the diagnosis of Kümmell's disease would appear to be fairly established. In the light of our present knowledge, this appears to be the best evidence for such a diagnosis. Even this criterion may be criticized on the ground that a true fracture may be present without being visible on the first roentgenograms. Although this may be true, such a fracture of a vertebral body, if followed by compression of a definite degree, would be sufficiently different from the ordinary type of fracture of the spine to justify its allocation into a separate group.

Kümmell,[10,11] himself, has pointed out that there are very few case reports in which adequate roentgen examination was made immediately after the injury and found negative. He states that he, personally, has seen a number of cases in which the roentgen examination was negative at the time of the injury and for several weeks after. Sometime later, after the onset of more severe symptoms, another roentgen examination revealed a compression of one or more vertebral bodies. This type of case would seem to fulfill the criteria of a case of Kümmell's disease. Unfortunately he fails, in both his last publications,[10,11] to detail the number of such cases he has seen or their histories, and does not publish the roentgenograms. He calls attention to the cases of Redard,[15] Brodnitz[3] and Nonne[13] as being roentgenologically negative at the time of injury, and becoming positive much later. The latter two cases will hardly stand critical analysis, the later roentgenograms showing findings chiefly in the intervertebral discs while the bodies of the vertebrae are hardly compressed. Furthermore these cases were reported at a time when it is doubtful that the roentgen technique was sufficiently good to rule out a small fracture of the vertebra. In fact, Kümmell[10] cites cases in which a negative roentgen diagnosis was made on the first examination, but upon later reviewing the roentgenograms the evidences of a fracture were found.

It seems unnecessary to again review the voluminous literature on this subject as it has been dealt with so well in previous publications.[1,2,8] Suffice it to say that there are, no doubt, a number of authentic cases in which the criteria here set forth for the diagnosis of Kümmell's disease are fulfilled. These cases, however, are exceedingly uncommon. The most recent reports in the English language are illuminating in this regard. Gorsch[7] reported a case in which roentgen examination was apparently negative at the time of injury with compression appearing later. He did not, however, see the original roentgenograms himself and does not publish them. Baker[1] reports 8 cases in none of which did he see the original roentgenograms and in none of which could he have been certain that no fracture was demonstrable at the time of injury. In 5 of his cases there had been a roentgen examination at the time of injury but in only one could he obtain the original report, which was negative. Cardis, Walker and Olver[4] report 14 cases, but in only one of them were the roentgen findings negative immediately after the injury. The roentgenograms were not published. Jones[8] reported one case but in this there was no examination for several years after the injury. In the most recent contribution by Blaine[2] none of the 10 cases which he reports had had a roentgen examination at the time of injury, so there is no definite evidence that they were not simply fractures with delayed symptoms.

The cases in which roentgen examination was made some time after the injury with negative findings but later became positive are even more uncommon. Kümmell[10,11]

mentions such cases but not specifically as to number or as to the exact nature of the findings.

The following case seems to fulfill the requirements, at least from a roentgenological viewpoint, and would seem to establish clearly that an injury to the spine may occur which will give no roentgen evidence for as long as two months and yet eventually show a marked compression of the bodies of the vertebrae.

CASE REPORT

A white woman, aged fifty-five, fell down the cellar steps April 14, 1927. She received a severe injury, being confined to her bed for seven weeks with pain and weakness. There was no paralysis. She reported to the Out-Patient Department of the University of Minnesota Hospital on June 17, 1927, about two months after the injury. At this time she had pain in the lower dorsal region of the spine and marked weakness. Physical examination revealed an apparent depression in the lower portion of the thoracic spine but nothing else of significance. There were no abnormal neurological findings.

Fig. 1. Lateral roentgenogram of thoracic vertebrae made two months after injury. Arrows indicate the normal-appearing seventh and ninth thoracic vertebrae.

Fig. 2. Lateral roentgenogram of thoracic vertebrae made nine months after Figure 1. Arrows indicate the seventh and ninth vertebral bodies. Note the marked narrowing and atrophy of the bodies compared with their appearance in Figure 1. Comparison should also be made with the normal height of the eighth and tenth vertebral bodies. Note also the apparent increase in the size of the seventh and eighth intervertebral discs.

Roentgen examination on June 24, 1927, revealed a characteristic compression fracture of the body of the twelfth thoracic vertebra and a slight compression of the body of the fifth cervical vertebra. There was no dislocation or displacement of either. The thoracic vertebrae were otherwise normal, as is well shown in Figure 1, which is a lateral view of this region. Particular attention is directed to the bodies of the seventh and ninth thoracic vertebrae.

She was put in a Goldthwait-Taylor brace.

On April 5, 1928, about nine and one-half months later, she returned complaining of in-

creasing pain in the middle of the thoracic spine and particularly of increasing kyphosis. The latter was obvious on physical examination but no other findings were apparent and there was no real gibbus.

Roentgen examination at this time revealed only a slight increase in density in the fractured twelfth thoracic vertebra and possibly a slight dislocation of the fifth cervical. There was some diffuse decalcification of the whole spine. In addition, as shown in Figure 2, which is a lateral view of the thoracic spine, a marked narrowing of the bodies of the seventh and ninth thoracic vertebrae was shown. A comparison of Figure 2 with Figure 1 shows clearly the marked change which had occurred in these two vertebral bodies. There is evident a fairly marked compression with apparent increase of the size of the intervertebral disc. These two vertebrae do not have the typical wedge-shape of an ordinary compression fracture, but resemble rather the appearance seen with extreme osteoporosis of age. This is consistent with the theory that the expansion of the intervertebral disc produces this condition. Furthermore, there was no lateral compression or displacement. The first lumbar vertebra showed a somewhat similar appearance but to a lesser degree.

COMMENT

Several features of this case are notable. Although the first roentgen examination was made more than two months after the injury, the vertebrae which later showed the disease were still roentgenologically normal. This demonstrates clearly how long a period may elapse before the changes which Kümmell described become obvious. The vertebral bodies which later became involved were somewhat removed from the originally fractured vertebrae. Although there was considerable disability from the known injury this was distinctly increased by the change in those vertebrae affected by Kümmell's disease. This is a fact which should be borne in mind especially as related to medico-legal problems. It indicates that the extent of the disability which may occur following a spinal injury cannot be foretold, even though the fractured vertebrae be obvious, because the possibility that other vertebrae will later become compressed is always present. The case further bears out clearly the fact that absence of roentgen findings immediately, or for as long as two months (and probably much more), after an injury does not exonerate any particular vertebral body, even though there is no further trauma, from later showing compression.

SUMMARY AND CONCLUSIONS

Many of the reports of Kümmell's disease may likely be merely cases of delayed symptoms following an unrecognized vertebral fracture.

The diagnosis of Kümmell's disease is hardly justified unless a careful roentgen examination made after the injury is negative and later roentgenograms show positive findings.

The degree of disability following spinal injury cannot be foretold even if one or more of the vertebrae are obviously fractured. Some of the others, although apparently normal at the outset, may later develop compression.

Every case of spinal injury, no matter how slight, should be carefully examined roentgenologically, and if any symptoms continue, the examination should be repeated at intervals.

A case of spinal injury first seen two months after the accident is reported. Although there was at that time an obvious compression fracture of two of the vertebral bodies the remainder of the spine appeared normal. Seven months later definite compression of two of the previously normal-appearing thoracic vertebrae could be seen. This case fulfills the criteria of a true case of Kümmell's disease.

REFERENCES

1. Baker, R. H. Compression fracture of vertebral bodies with delayed symptoms (Kuemmel's disease) with report of seven cases. *Surg., Gynec. & Obst.*, 1920, *31*, 359.

2. Blaine, E. S. Spondylitis traumatica tarda (Kuemmell's disease). *Radiology*, 1930, *15*, 551–563.

3. Brodnitz. Die Kümmell'sche Wirbelerkrank-

ung. *Zentralbl. f. Chir.*, 1903, *30*, 902.

4. Cardis, J., Walker, G. F., and Olver, R. H. Kümmell's disease. *Brit. J. Surg.*, 1928, *15*, 616–625.
5. Geist, Emil. Personal communication.
6. George, A. W., and Leonard, R. D. The Vertebrae Roentgenologically Considered. (Volume vii, *Annals of Roentgenology*). Paul B. Hoeber, Inc., New York, 1929.
7. Gorsch, R. V. Compression fracture of first lumbar vertebra with delayed symptoms (Kuemmel's disease). *Ann. Surg.*, 1921, *73*, 360.
8. Jones, F. Compression fracture of spine developing delayed symptoms (post-traumatic spondylitis or Kümmell's disease). *J. Am. M. Ass.*, 1923, *81*, 1860–1867.
9. Kümmell, H. Ueber die traumatischen Erkrankungen der Wirbelsäule. *Deutsche med. Wchnschr.*, 1895, *21*, 180–181.
10. Kümmell, H. Die posttraumatische Wirbelerkrankung (Kümmellsche Krankheit). *Arch. f. klin. Chir.*, 1921, *118*, 876–901.
11. Kümmell, H. Die posttraumatische Wirbelerkrankung sogenannte Kümmellsche Krankheit. *Monatschr. f. Unfallh.*, 1928, *35*, 65–78
12. Mauclaire and Burnier. Déformations vertébrales traumatiques tardives (maladie de Kummell-Verneuil). *Arch. gén. de chir.*, 1912, *8*, 274–306.
13. Nonne. Quoted from Kümmell, ref. 10.
14. Osgood, R. B. Compression fractures of the spine; diagnosis and treatment. *J. Am. M. Ass.*, 1927, *89*, 1563–1568.
15. Redard, P. Ueber Wirbelsäulenverletzungen durch Betriebsunfall. *Ztschr. f. orthop. Chir.*, 1909, *24*, 80–86.
16. Roberts, P. W. Fracture of the vertebrae without cord symptoms. *Surg., Gynec. & Obst.*, 1916, *22*, 198–201.
17. Sever, J. W. Compression fractures of the lumbar vertebrae; a report of seven cases. *Surg., Gynec. & Obst.*, 1916, *22*, 338–343.
18. Steindler, A. Diseases and Deformities of the Spine and Thorax. C. V. Mosby Co., St. Louis, 1929.

ENCEPHALOGRAPHY: AN EXPLANATION OF A POSSIBLE ERROR IN TECHNIQUE*

By EUGENE P. PENDERGRASS, M.D.
PHILADELPHIA, PENNSYLVANIA

THE literature on encephalography has increased considerably during the last few years, probably paralleling the popularity of the procedure. In spite of increased experience there are many problems that are still obscure and it is for that reason the following case is presented:

M. G., male, aged seventeen, was admitted to the Surgical Division of the University Hospital on the service of Dr. Charles H. Frazier.

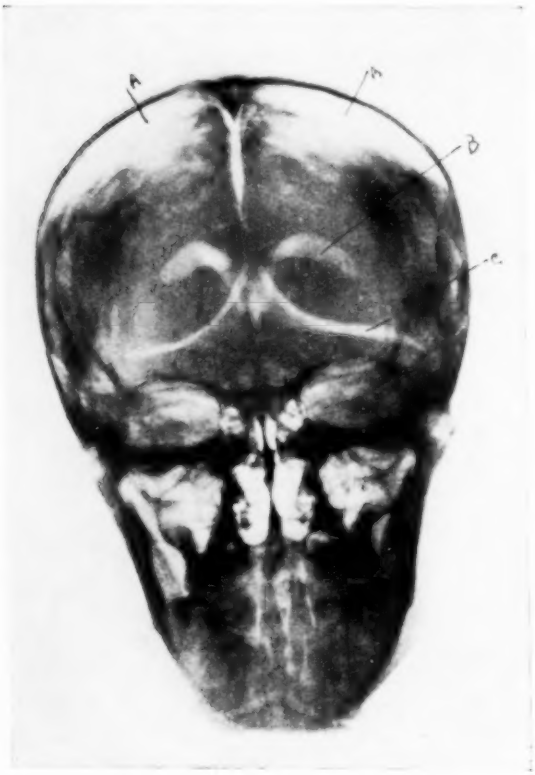


FIG. 1. At *A*, a large collection of air can be seen depressing the cortex. No convolution markings are demonstrated, making one think that the air was subdural instead of being subarachnoid. The ventricles *B* are flatter than normal, suggesting that the subdural air has collapsed the ventricle to some extent. There is a large subdural collection of air under the tentorium seen at *C*. Encephalogram by Dr. Duane; 147 c.c. fluid removed and 157 c.c. air injected.

FIG. 2. Lateral view. Same case as in Figure 1. Note the large frontal collection at *A* and under the tentorium at *B*. The ventricles are encroached upon at *C*. The cisterna pontis (*D*) is quite small and the cisterna chiasmatis is scarcely visible.

The patient gave a history of convulsive seizures. After thorough study, an encephalographic examination was recommended and made.

Two views (Figs. 1 and 2) represent the appearance found. No attempt was made to interpret the roentgenograms because of the peculiar distribution of air over the cortex, and another examination of the patient was requested.

The second encephalographic examination was made one week later (Figs. 3 and 4). At this time there was no hesitancy in making an interpretation of slight atrophy in the frontal and parietal regions.

COMMENT

In the past we have made diagnoses of advanced atrophy of the cortex in some patients who have had large collections of air at the vertex and underneath the tentorium such as is seen in Figures 1 and 2. At those times we have asked ourselves and some of our confrères whether the arachnoid mem-

* From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Pa.

brane was capable of being stretched to such a degree. No one had seen such a stretching and because of this we have hesitated to make roentgen interpretations on such cases. Yet we have made incorrect interpretations, and illustrations of such cases have been included in publications from time to time (Fig. 5).

The encephalographic committee recognized the differences in the roentgenographic appearances between subarachnoid air and subdural air and described them, but for some reason we have overlooked the differences in some of our interpretations in our desire to make a diagnosis.

Fig. 3. Same case as Figure 1. Encephalogram made one week later. Note that there is very little, if any, space between the cortex of the brain and the bones of the vault. The ventricular system is normal in outline and there is an absence of a large collection of air underneath the tentorium. Compare the appearances of this examination with those found in Figure 1. In Figure 1 the air is subdural, in Figure 3, same case one week later, the air is subarachnoid. Encephalogram by Dr. Duane; 158 c.c. of fluid removed, 170 c.c. of air injected.

In one of our earliest presentations we called attention to the roentgenographic appearances found in the same patient from day to day (Figs. 6 and 7). In Figure 6, the air was thought to be subarachnoid, and subdural in Figure 7.

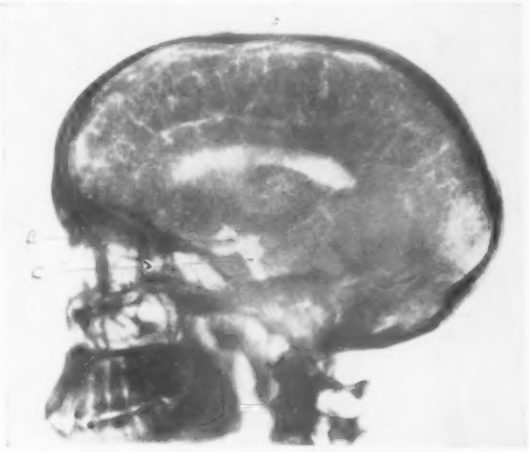


Fig. 4. Lateral view of the same case as Figures 2 and 3. In this view the subarachnoid cortical markings are clearly outlined (*A*) surrounding and clearly demarcating the convolutions of the brain. The markings are slightly increased in the frontal and parietal regions, suggesting thereby that there has been slight brain atrophy. The cisterna chiasmatis (*B*) and cisterna pontis (*C*) are clearly visible. Compare appearances of these two regions with those found in Figure 2. In Figure 4, the air is subarachnoid and in Figure 2, the air is subdural.

Our thoughts with regard to the appearances of subdural and subarachnoid air, however, have never been proved by operation. However, when we had the opportunity to study the roentgenographic appearances found in the two examinations we came to the conclusion that in the first (Figs. 1 and 2), the air was subdural and in the second (Figs. 3 and 4), the air was subarachnoid.

In searching for a possible explanation as to why at one time the air may be subdural and at another time subarachnoid, we found some difference of opinion. Some of our confrères thought that during the drainage of the cerebrospinal fluid, manipulation of the head and the introduction of the air, the arachnoid was injured at the base of the

Fig. 5. The patient was a girl, aged nine, with a history of generalized convulsions. She was on the service of Dr. Charles H. Frazier in 1928, and encephalography was carried out by Dr. James Gardner. The roentgen interpretation was as follows: Extensive and unilateral brain atrophy on the right side at *A*. The absence of air over the cortex on the left side at *B* was interpreted as arachnoiditis. In the light of our present knowledge we would have given the following interpretation: Error in surgical technique due to a combined injection of air in the subarachnoid and subdural spaces. Large collections of subdural air can be seen at *A* and *C*. The ventricle is encroached upon at *D*. Subarachnoid air is seen at *E*. With such an appearance it would be impossible to give an accurate interpretation. The failure of the left cortex to be depressed by the subdural air suggests arachnoiditis obliterating the subdural space.

Fig. 6. Note the equal distribution of the air over the cortex in the subarachnoid cortical markings outlining the convolutions. Compare with appearances found in Figure 7.

skull, thereby allowing air to escape into the subdural spaces. Others felt that the lumbar needle was introduced primarily into the subdural space and the arachnoid was injured enough to allow drainage of the fluid, and the air was introduced directly into the subdural space and travelled up the spinal canal. It seems to me that Dr. James Gardner offered this opinion in 1928 and was the first to call it to my attention. Possibly both explanations may play a part in a given case or wholly and separately in other cases.

It seems to us, however, that the injury of the arachnoid by the lumbar puncture needle is probably the simplest way to explain the error in technique and our deductions in this report have been from that standpoint. In Figure 8, I have attempted to illustrate the mechanism of this error in technique. The lumbar puncture needle is introduced into the spinal canal 1 in the interspace between the fourth and fifth lumbar vertebra. The cauda equina has divided into separate nerve trunks and there is less chance of injury. Sometimes the lumbar needle is introduced far enough to strike the posterior wall of the body of the vertebra. The patient may experience pain and jerking of one of the lower extremities from the injury of a nerve trunk. When this occurs the needle is withdrawn slightly. Both the dura *A* and arachnoid *B* have been injured. This allows fluid to escape from the subarachnoid space into the subdural space. After some of the fluid is withdrawn, the subarachnoid space tends to collapse just as it does when it is cut during a laminectomy. When the subarachnoid space is obliterated by the collapse of the arach-

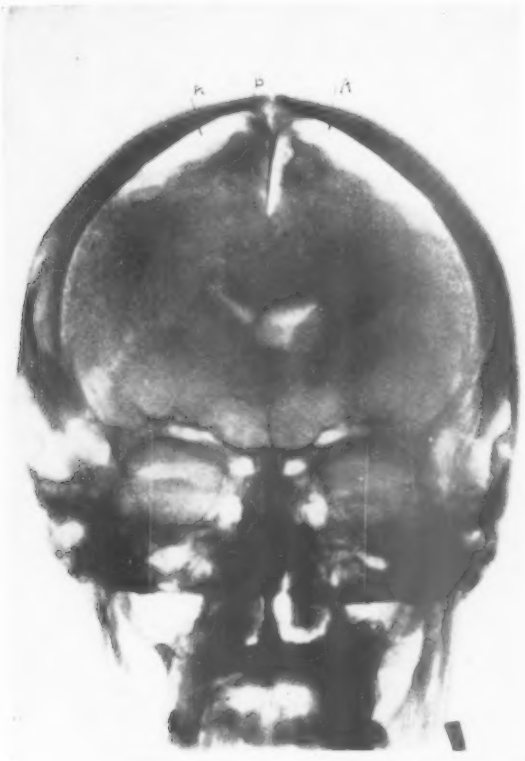


Fig. 7. Same case as Figure 6. This examination was done twenty-four hours after the first examination and we felt that the space found at *A* represented air that had become subdural as it passed to the vertex for absorption, and because of this tendency we recommended the exposing of the roentgenograms within one hour following the introduction of the air into the cerebrospinal system. One can clearly see the differences in the two roentgenographic appearances. Note the longitudinal sinus at *B*.

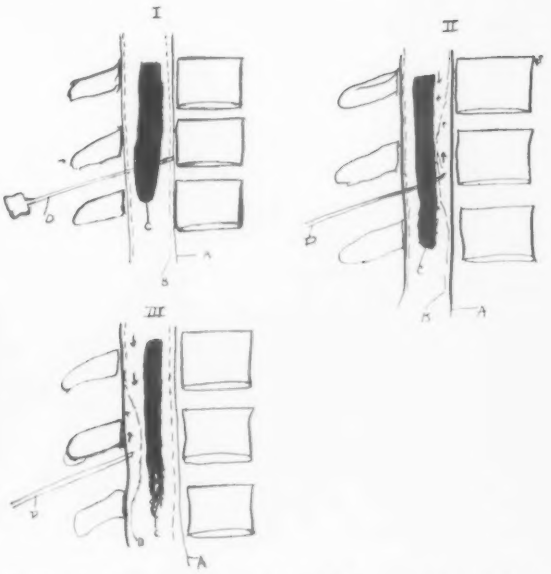


Fig. 8. Schematic drawing of the position of the lumbar needle during drainage of the cerebrospinal fluid system and replacement of spinal fluid with air. *A*—Dura mater. *B* (dotted line)—Arachnoid membrane. *C*—Nerve trunks in spinal canal. *D*—Lumbar puncture needle. In II and III the arachnoid has collapsed, the point of the needle is in the subdural space. The arrows pointing down represent the direction of the flow of cerebrospinal fluid from the subarachnoid space and the arrows pointing up represent the air passing up the subdural space.

noid, the subdural space becomes quite large. Then air is introduced and it passes up the subdural space. This cycle is repeated time after time until the canal is drained. The arrows indicate the fluid flowing out of the subarachnoid space and the air ascending the subdural space. Another possible explanation is seen in Fig. 8, III. We have not been able to absolutely correlate these explanations with actual difficulty in draining the spinal canal but we are of the opinion that the air is more likely to be introduced into the subdural space when one has a great deal of difficulty of draining the canal than otherwise. We have been told on several occasions that drainage was difficult after 30 to 40 c.c. of cerebrospinal fluid had been removed; and in some of these cases, what has been interpreted as subdural air has been found. In fact we have marvelled that subdural air is not found more frequently than it is.

CONCLUSIONS

A case is presented showing the difference between subarachnoid and subdural collections of air.

We have advised against making interpretations of roentgenograms demonstrating subdural air.

Subdural air is regarded as an error in the surgical technique.

An explanation is offered for the occurrence of the error in technique.

INTRAUTERINE ROENTGEN CEPHALOMETRY AND PELVIMETRY*

By HENRY J. WALTON, M.D.
BALTIMORE, MARYLAND

MUCH has been written about roentgen pelvimetry and a large number of methods have been described, most of which have been too complicated to be practical, but until recently scarcely any mention has been made of roentgen cephalometry. It is just as important to know the size of the unborn child's head as it is to know the dimensions of the pelvic inlet, for it may be as impossible to deliver a hydrocephalic child through a normal pelvic canal as it would be to deliver a normal child through a contracted pelvis; and unless the roentgen examination can determine the size of the fetus, the pelvic measurements must necessarily be of limited value.

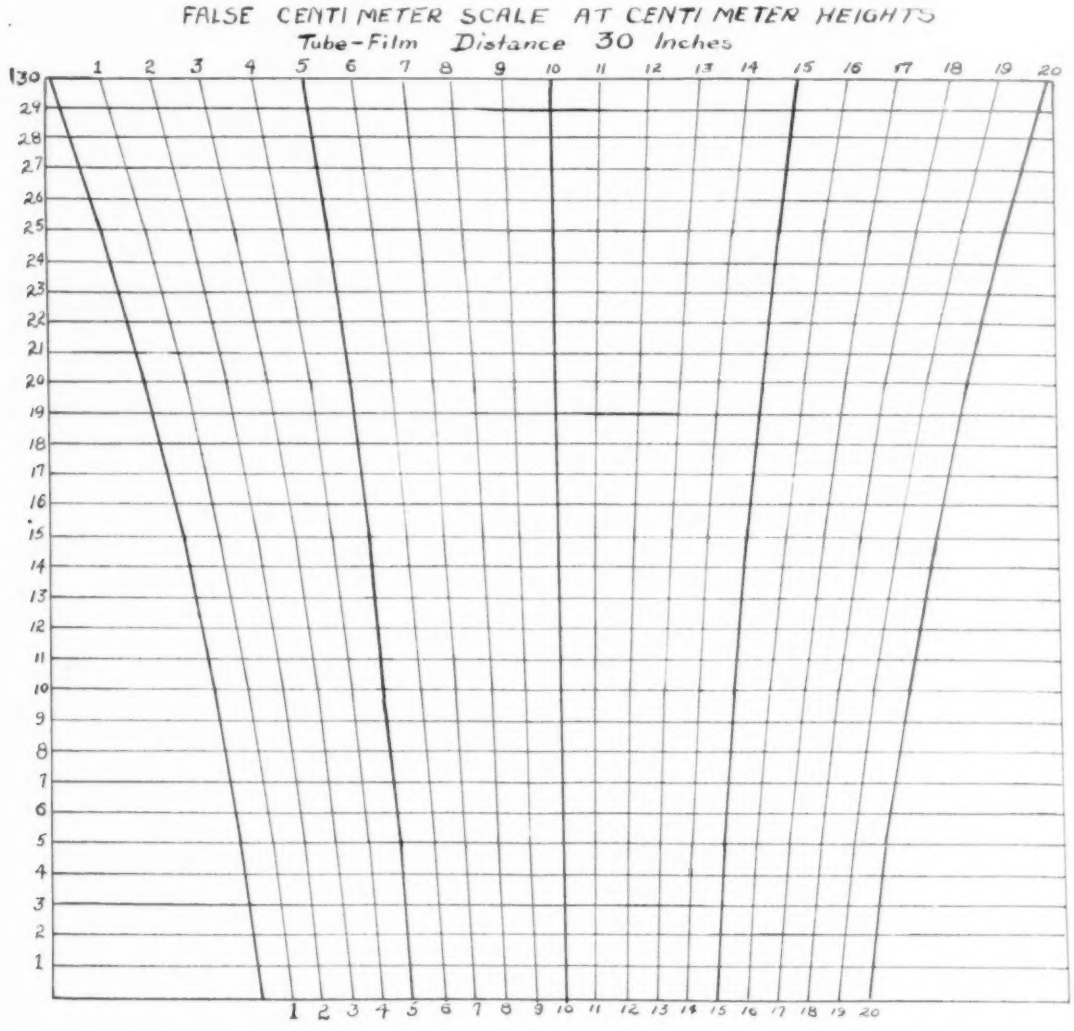


FIG. 1. The bottom line represents actual centimeter measurements on surface of the film. The lines above show the degree of distortion at centimeter heights above the film with a tube-film distance of 30 inches.

* Presented at the Roentgenological Conference, Baltimore, Md., Feb. 6–7, 1931.

The following method of measuring the diameters of the maternal pelvic inlet and fetal skull has been used in the Roentgenological and Obstetrical Departments of the University of Maryland for over two years, and its simplicity and practicability recommend its general adoption.

Fig. 2. Semi-reclining posture according to Thoms. *TF*—Tube-film distance 30 inches. *SF*—Symphysis-film distanc in centimeters.

The false centimeter chart (Fig. 1) which is used to correct the distortion on the roentgenogram of the part to be measured, was drawn from a series of roentgen exposures of a metal perforated centimeter rule, at heights ranging from 1 to 30 cm. above the film, using a 30 inch tube-film technique. The patient is placed on the Potter-Bucky diaphragm in the semi-reclining position, described by Thoms.[1] The back is supported at a proper angle to bring the plane of the pelvic inlet parallel with the roentgen film (Fig. 2). The distance between the film and top of the symphysis pubis (which represents the plane of the superior strait) is measured in centimeters (*SF*, Fig. 2). The target of the tube is then placed 30 inches above the film and the central ray directed vertically through the center of the pelvis. The exposure made in this position shows the outline of the pelvic brim enlarged in proportion to its height above the film.

After the film is developed, the anteroposterior, oblique and lateral diameters of the pelvic brim are measured with calipers and checked against the chart (Fig. 1) on the line corresponding to the height of the symphysis above the film at the time of exposure (*SF*, Fig. 2), and the corrected or true measurements of the pelvic inlet are obtained.

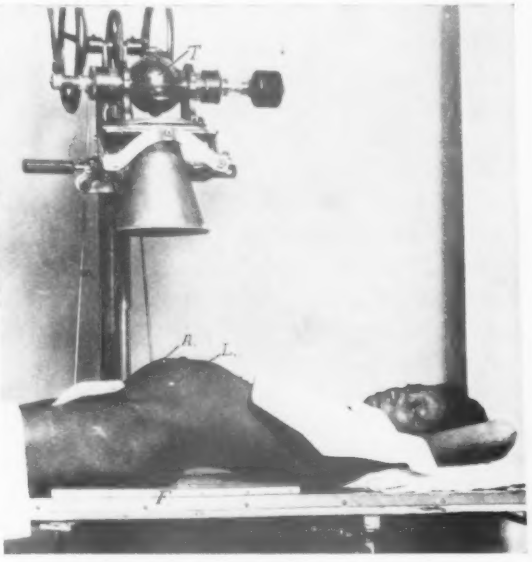


Fig. 3. Recumbent posture. *A*—Point on anterior abdominal wall over center of baby's head. *L*—Point on lateral abdominal wall nearest to center of baby's head. *LF*—Height of center of baby's head above film.

The same procedure is followed in making the cranial measurements. The patient now lies flat on the table (Fig. 3). The position of the head of the child is located as accurately as possible either by manual or roentgen examination. A mark is placed on the anterior abdominal wall immediately above the center of the child's head (*A*,

[1] Thoms, Herbert. X-ray pelvimetry; simplified technique. *Surg., Gynec. & Obst.*, 1927, *45*, 827–828.

Fig. 3). A second mark is placed on the lateral abdominal wall on the side nearest to and directly opposite the center of the child's head (*L*, Fig. 3).

The first exposure is made by centering the tube 30 inches above the film over mark *A*. The distance is measured in centimeters between *L* (which represents the approximate center of the child's head in the horizontal plane) and the film *F*. For convenience and as a check against error, the distance *L F* is written on the film in pencil before it is developed.

The next exposure is made laterally (Fig. 4). The film is placed against the lateral abdominal wall covering *L*, and the tube is centered on the opposite side of the patient 30 inches from the film. The distance is measured in centimeters between *A* (which represents the approximate center of the child's head in the vertical plane) and the film *F*, and the measurement *AF* written on the film.

After the films are developed, the fronto-occipital and biparietal diameters of the fetal skull are measured with calipers and checked against the chart at heights corresponding to the respective distances between the center of the skull and film *LF* and *AF*, and the corrected or true measurements of the fetal head are obtained.

In vertex presentations, by determining the height of the fetal skull above the film when the pelvic exposure is made with the patient in the semi-reclining position, an additional view is obtained from which cranial measurements can be made.

These three views of the skull taken in different directions are usually sufficient to give all the measurements required.

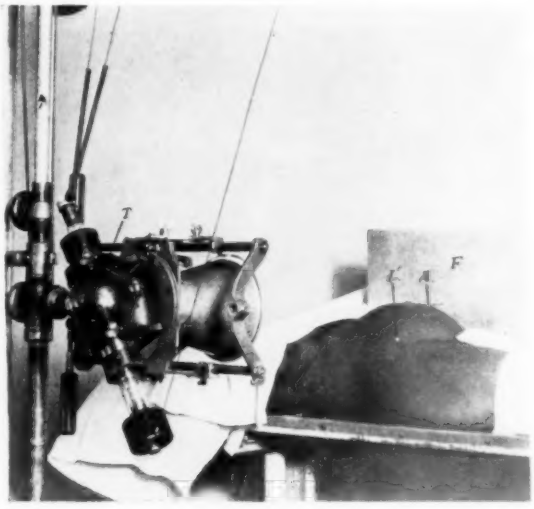


FIG. 4. *A*—Point on anterior abdominal wall over center of baby's head. *L*—Point on lateral abdominal wall opposite baby's head. *AF*—Distance between center of baby's head and film.

The advantages of this method are that it is easy to perform, does not require any special or complicated apparatus, is not time-consuming or objectionable to the patient, the technical work can be safely carried out by trained technicians and after the films are developed, all the measurements can be made in a very few minutes.

Vol. XXV, No. 6

TREATMENT OF OSTEOGENIC SARCOMA BY MEANS OF IRRADIATION*

By G. E. PFAHLER, M.D., Sc.D., *and* L. D. PARRY, M.D.
PHILADELPHIA, PENNSYLVANIA

WE prepared this paper on the basis of a discussion on the treatment of "Bone Tumors." Such discussion would require a large book, but even when condensed, we found it entirely too comprehensive for the limited time at our disposal, and at the last minute, have reduced this title to the above subject. We hope to present other phases of this subject at some future date. Even with this limited title, we are compelled to make some rather dogmatic assertions which would seem quite proper if they were fully discussed.

The diagnosis and differential diagnosis of osteogenic sarcoma involves great difficulties. Yet, unless the diagnosis is accurately made, all other discussion is of no avail. The diagnosis of a bone tumor demands an accurate history of the symptoms, the rate of development, and a most complete set of roentgenograms properly interpreted. Such roentgenograms must be made at various angles, and often films must be made of different parts of the body, and always of the lungs when there is a possibility of malignant disease.

In nearly all, or at least the great majority of cases, the expert radiologist can make a diagnosis if the history and clinical symptoms are taken into consideration. Very often the comparative study of other parts of the body is neglected and much time is lost in discussion that could be better spent in investigation.

A biopsy will be helpful in making a diagnosis, providing the specimens are well taken, and the sections studied by an experienced tumor pathologist. When the expert radiologist is in doubt, the pathologist is also often in doubt, or if the microscopical slides are sent to several equally expert pathologists, the opinions are apt to differ. The difficulty in making an accurate diagnosis from the section alone is indicated by the fact that the Registry of Bone Sarcoma—so well started by Codman—demands a complete history, a complete set of roentgenograms (or a series of them) as well as the section. Even the great tumor pathologist, Dr. James Ewing, says that the roentgenograms are of equal or greater importance than the microscopical section. Kolodny often finds that with a good clinical history and roentgenograms, one can be as sure of a diagnosis as from seeing the patient, the lesion, the gross specimen and numerous sections, and adds, "Not infrequently a roentgenogram is more decisive than a number of microscopic sections."

This naturally raises the question as to the advisability of doing a biopsy preceding operation or radiation treatment. There has been no definite proof that biopsy is detrimental, but on theoretical grounds, it is thought inadvisable by a number of authors (Seitz, Wintz, Holfelder and others). It is known that any traumatism to a malignant growth breaks the barrier and hastens its development and leads to metastasis. Such traumatism is followed by congestion and the increased blood supply will tend to increase growth. This objection can be overcome by previous irradiation or operation immediately following. It is also well known that in the case of sarcoma of bone, there is a great tendency toward distant metastases—usually to the lungs—and this takes place by emboli. Operation often delays radiation treatment and increases the difficulties because of the wound. The type of malignant growth cannot always be determined by roentgenograms, but in nearly all instances, it is possible to decide whether a bone tumor is malignant. Kolodny, who has reviewed all the material in over 700 cases in the Registry

* Read at the Thirty-first Annual Meeting, American Roentgen Ray Society, West Baden, Ind., Sept. 23-26, 1930.

of Bone Sarcoma says, "Although a biopsy of bone is frequently advocated by surgeons, it is significant that pathologists most experienced in bone tumors raise their voices against probatory incisions in cases of malignant bone tumors." The aspiration method recommended and used by Martin and Ellis in 60 cases of bone tumors may have less objection.

In all cases, it would seem advisable to give preliminary irradiation before doing a biopsy. This will tend to devitalize the malignant cells and thus make biopsy a safer procedure. The preliminary irradiation will also be useful in determining the radiosensitivity of the tumor. "Round cell sarcomas" and "giant cell tumors" are thought to be more radiosensitive but the final test is the irradiation itself. Kolodny says that the myeloma is the only true round cell tumor occurring in bone.

Each patient should be considered individually, and from this standpoint it would seem that a biopsy should be reserved for the cases in which malignancy cannot be determined, and in which operation depends upon such a diagnosis. From the standpoint of science and for the sake of determining the relative value of any therapeutic measure, it is desirable to have a biopsy in every case. Twenty or more years ago, many cases of bone tumors were reported histologically as sarcoma that are not considered malignant today. We believe that one of us (G. E. P.) was the first, in 1906, to treat such a case of giant cell tumor, diagnosed microscopically "round cell sarcoma" after biopsy. A series of roentgenograms was made extending over a period of twenty-two years which showed progressive healing of this tumor, but today, we know very well that we were dealing with a giant cell tumor as judged by the roentgenograms alone.

The careful study of over 700 cases of bone tumors by experts in the Registry of Bone Sarcoma justifies our accepting the classification as reported by Kolodny and the therapeutic indications may also be briefly classified as follows:

1. Metastatic tumors primary in tissues other than bone (breast, thyroid, prostate, stomach, uterus)—*irradiation.*
2. Periosteal fibrosarcoma—*irradiation*, probably followed by *amputation.*
3. Osteogenic tumors; (*a*) benign (osteoma, exostoses, chondroma)—*excision;* (*b*) malignant (periosteal, medullary and subperiosteal, sclerosis, telangiectatic)—*irradiation*, possibly followed by *amputation.*
4. Inflammatory conditions—*irradiation.*
5. Benign giant cell tumors (osteitis fibrosa localisata, "Riesenzelltumoren"), (granuloma including nasal fibroma, adamantinoma, myositis ossificans)—*irradiation.*
6. Angiomata: (*a*) benign—*surgery;* (*b*) malignant—*irradiation*, probably followed by complete *excision* or *amputation.*
7. Ewing's sarcoma—*irradiation.*
8. Myeloma—*irradiation.*

The two methods of treatment which have been found of practical importance are irradiation and surgery. We will confine our report to the *results to be expected from irradiation, as judged* by the reports in the literature and our own experience. The general surgical aspects will not be discussed except as related to the radiation treatment.

Under the heading of *osteogenic sarcoma*, we must classify all solitary malignant tumors of bone. These are not equally radiosensitive. Those studied microscopically and reported as "round cell sarcomas" are generally considered the most sensitive, the periosteal sarcomas being the most radioresistant. From the standpoint of the radiologist, the more slowly growing and the more bone productive, the more radioresistant is the tumor.

Holfelder, who is recognized as a great leader in roentgen therapy, has made an encouraging report upon 25 cases treated by him with deep roentgen therapy during the five years preceding July, 1926. Of these, 16 have been under observation more than three years, and the other 9 more than two years since the conclusion of treatment. Six out of the 16 have been well over three years, and 3 of these 6 have been well over five years. Of these 6 well cases, 3 were con-

firmed by microscopical examination. Of the 25 cases, 10 have died. Of the 9 cases that have been under observation less than three years, 7 are clinically well from one to two years, and of these 7 cases, 6 have had histological examinations. (He also calls attention to one other case that recurred after five years.)

The *value of histological examinations* according to Holfelder is chiefly for statistical purposes. He has not found it of assured value in determining the sensitivity to irradiation, nor in making a prognosis. In some cases in which a diagnosis of sarcoma could not be made and in which the tumor was believed to be histologically benign, the patient died of metastatic sarcoma. (We have had similar experiences.)

Evans and Leucutia have reported on 12 cases as follows:

1. Registered. Spindle cell sarcoma of ilium. Recurrence two years. Deep roentgen therapy; changed to osteochondrosarcoma at death, 2½ years.
2. Not registered. Osteogenic sarcoma, frontal and sphenoid; roentgen therapy; well, 5 years.
3. Registered. Osteogenic sarcoma, ilium plus lung metastases; roentgen therapy; well, 6 years.
4. Registered. Osteogenic sarcoma, fibula; recurrence; preoperative and postoperative roentgen therapy; well, 5 years.
5. Registered. Osteogenic sarcoma; histological examination, inflammatory process; roentgen therapy; well, 5 years.
6. Registered. Ewing's tumor—multiple; roentgen treatment; well, 1 year.
7. Not registered. Round cell sarcoma of palate; preoperative and postoperative irradiation; well, 3 years.
8. Not registered. Multiple chondrosarcoma; roentgen therapy; stationary, 4 years.
9. Not registered. Myxoma of metacarpal; curettage and roentgen therapy; well, 5 years.
10. Not registered. Spindle cell sarcoma of ilium; resection and roentgen therapy; well, 2 years (died of perforated appendix after 2 years).
11. Registered. Giant cell tumor of femur; biopsy, infection, amputation.
12. Registered. Giant cell tumor of femur; roentgen treatment; bone regeneration; clinically well, 4 years.

Excellent reports have also been made by Herendeen, Soiland, Borak, Kienböck, and others, in America and Europe.

The following table gives a summary of our cases (Table 1).

It will be observed that of 58 cases of osteogenic sarcoma 63.8 per cent are males, and 36.2 per cent are females. The average duration of the disease before our treatment was 1.4 years. Of the 58 cases of osteogenic sarcoma 41 were confirmed by microscopical examination. The other 17 were so far advanced as to need no such confirmation. Of these 58 cases, 16 were treated by deep roentgen therapy or radium packs, and of the 16 cases, 7 have been symptom-free from 1 to 9 years (1, 1½, 2½, 3, 6, 8, 9). Of these 16 cases, 9 died in from 2 months to 7½ years after treatment (1/6, 1/2, 1, 2, 3, 4, 6, 7¼ years).

The following Table II will show that of 39 cases of osteogenic sarcoma, (histological report), 14 (35.8 per cent) are symptom-free from 1 to 10 years (of these 30.5 per cent are symptom-free 3 years and 19.3 per cent are well after 5 years or more), while of those diagnosed upon clinical and roentgen evidence only 3 out of 17 recovered (17 per cent), which indicates that they were of a more advanced type.

We have the impression that heavy radium packs (300 to 400 mg.) are more effectual than roentgen rays, but they are generally not used because of the increased expense.

We agree with Holfelder that all cases of osteogenic sarcoma should be given a trial by irradiation, since the results are at least as good or better than those following the most radical operation. Holfelder formerly advised against a biopsy, but now advises a biopsy in all cases in which the patient will consent, *but only after preliminary irradiation over a period of a month.* Under these circumstances he has seen no disadvantages. This, too, is our recommendation. He and we have seen rapid metastasis follow biopsy in carcinoma of the breast, even when an immediate operation has followed. This has made him and us fearful. He has seen no such metastasis when preliminary irradiation has been given.

In all cases of bone tumor in which malig-

TABLE I

OSTEOGENIC SARCOMAS—58 CASES

Cases	Region	Date	Age	Sex	Known Duration	Operation	Pathological Report	Recurrence	Metastases	Symptom-Free	Dead After
1	Occiput	1925	24	M	10 mo.	Excision	Positive	No	None	3 yr. not reported 2 yr.	
1	Zygoma	1922	58	M	7 mo.	None	None	No	Lungs, pelvis		6 mo.
11	Inferior maxilla	1913	6	F	7 wk.	Excision	Positive	No	Neck		1½ yr.
		1916	11	M	7 mo.	None	None	No	Neck, arm abdomen		1 yr.
		1919	30	F	1 yr.	Excision	Positive	No	None	6 yr. not reported 5 yr.	
		1921	62	M	6 wk.	Excision	Positive	No	Lungs		1 yr.
		1922	62	F	3 mo.	None	None	No	Neck		1 yr.
		1922	67	F	1 mo.	Excision	Positive	No	Neck		6 mo.
		1927	12	F	6 mo.	Excision	Positive	No	Lungs		1 yr.
		1927	40	M	7 wk.	Excision	Positive	Yes	Neck		2½ yr.
		1928	5	M	10 days	Excision	Positive	No	Neck		6 mo.
		1929	28	M	2 mo.	None	None	No	Lungs		6 mo.
		1930	18	M	2 mo.	Excision	Positive	No	Neck*	6 mo.	
2	Clavicle	1918	15	M	7 mo.	Excision	Positive	Yes	Lungs		2 yr.
		1922	34	M	3 yr.	Excision 2 oper.	Positive	Yes	Jaw, femur, lungs		3½ yr.
1	Rib	1928	37	M	6 mo.	Excision	Positive	Yes	Lungs		1 yr.
3	Radius	1916	4	M	9 mo.	Ampt.	Positive	No	Lungs		3½ yr.
		1920	13	M	5 yr.	Ampt.	Positive	Yes	Lungs		7½ yr.
		1927	19	F	2 mo.	Ampt.	Positive	Stump	Lungs		6 mo.
2	Ulna	1918	45	F	4 mo.	Ampt.	Positive	No	Lungs		2 yr.
		1926	16	M	9 mo.	Excision 2 oper.	Positive	No	Lungs		6 mo.
6	Ilium	1912	14	F	2 mo.	None	None	No	Lungs, sacrum		1 yr.
		1915	22	M	9 mo.	None	None	No	Lungs, sacrum		2 yr.
		1921	18	F	3 wk.	None	None	No	Lungs, sacrum		6 mo.
		1928	13	F	1 yr.	None	None	No	Sacrum, colon		1 yr.
		1928	27	M	7 mo.	None	None	No	Lungs, sacrum		1 mo.
		1930	54	M	4 mo.	None	None	No	Sacrum†	3 mo.	
1	Sacrum	1924	43	M	4 yr.	Excision 3 oper.	None	Yes	Lungs		3½ yr.
15	Femur	1913	19	M	9 wk.	Ampt.	None	Stump	None		1 yr.
		1916	20	F	5 mo.	Ampt.	Positive	Stump	Lungs		1 yr.
		1919	1½	F	15 mo.	Excision	Positive	Yes	None	10 yr.	
		1920	39	F	2 yr.	Ampt.	Positive	Stump	None		1 yr.
		1922	23	M	7 mo.	Ampt.	Positive	Stump	Lungs		4½ yr.

TABLE I (*Cont.*)

OSTEOGENIC SARCOMAS—58 CASES

Cases	Region	Date	Age	Sex	Known Duration	Operation	Pathological Report	Recurrence	Metastases	Symptom-Free	Dead After
		1922	42	M	5 mo.	None	None	No	Lungs, sacrum		4½ yrs.
		1922	61	M	2½ yr.	Excision	Positive	Yes	Lungs		6½ yr.
		1923	17	F	2 mo.	Excision	Positive	No	Lungs		1 yr.
		1921	16	M	1 yr.	Ampt.	Positive	No	None	9 yr.	
		1924	70	M	9 mo.	None	None	No	Lungs		1 yr.
		1927	18	F	6 mo.	Excision	Positive	Yes	Lungs		6 mo.
		1927	57	F	6 mo.	Excision	Positive	Yes	None	3 yr.	
		1928	17	M	1 yr.	Ampt.	Positive	No	None**	2½ yr.	
		1928	53	M	4 mo.	Excision 2 oper.	Positive	Yes	Lungs		1 yr.
		1928	58	M	31 yr.	None	None	Yes	Lungs#		2 yr.
13	Tibia	1905	46	F	8 yr.	Ampt.	Positive	No	Hand	5 yr. no trace 1910	
		1908	68	M	4 mo.	Ampt.	Positive	No	None		During operation
		1918	11	F	1 yr,	Ampt.	Positive	Stump	Lungs		6 yr.
		1922	30	M	1 yr.	Ampt.	Positive	No	Bone	8 yr.	
		1924	16	F	4 mo.	Ampt.	Positive	No	None	6 yr.	
		1925	33	M	2 mo.	None	None	No	Humerus, skull	5 yr.	
		1926	19	M	1 yr.	Excision	Positive	No	None	4 yr.	
		1927	65	F	2 yr.	Excision 4 op & ampt.	Positive	No	None	3 yr.	
		1922	24	M	5 mo.	Excision	Positive	No	None		Prob. 6 mo. no trace
		1929	21	M	11 mo.	Ampt.	Positive	No	None	1½ yr.	
		1929	19	M	7 wk.	Ampt.	Positive	No	None	1 yr.	
		1930	48	F	1 yr.	Ampt.	Positive	No	None	6 mo.	
		1930	43	M	5 mo.	None	None	No	None	3 mo.	
1	Fibula	1915	56	M	1½ yr. 6 oper.	Excision	Positive	Yes	Lungs		1 yr.
1	Calcaneum	1925	21	M	2 yr.	Excision 2 oper.	Positive	No	None	5 yr.	

* Still under treatment 6 months.
† Still under treatment 3 months.
** Still under treatment 3 months.
# Had a giant cell tumor and pathological fracture 31 years previously.

nant disease is a possibility, the lungs should be examined roentgenologically, and such examinations should be made from time to time during the treatment. In a number of cases, we have been able to trace metastatic lesions shown in the film made before treatment, though at the beginning they were too small to be recognized.

In recommending the preliminary "trial" by irradiation, one is confronted by the difficulty in deciding when this trial should

TABLE II

OSTEOGENIC SARCOMAS

With Microscopical Report 39 Cases		Clinical and Roentgen Diagnosis 17 Cases	
No. of Cases	Well	No. of Cases	Well
1	1 yr. after treatment	2	3 mo. after treatment (improved)
1	1½ yr. after treatment	1	5 yr after treatment
1	2 yr. after treatment	3	
4	3 yr. after treatment		
1	4 yr. after treatment		
1	5 yr. after treatment		
2	6 yr. after treatment		
1	8 yr. after treatment		
1	9 yr. after treatment		
1	10 yr. after treatment		
14			
No. of Cases	Deceased	No. of Cases	Deceased
7	6 mo. after treatment	1	1 mo. after treatment
8	1 yr. after treatment	3	6 mo. after treatment
1	1½ yr. after treatment	6	1 yr. after treatment
2	2 yr. after treatment	2	2 yr. after treatment
1	2½ yr. after treatment	1	3½ yr. after treatment
2	3½ yr. after treatment	1	4½ yr. after treatment
1	4½ yr. after treatment	14	
1	6 yr. after treatment		
1	6½ yr. after treatment		
1	7½ yr. after treatment		
25			

2 remaining cases are under treatment less than one year.
35.8 per cent well and symptom-free (14 out of 39 dases).
30.5 per cent well and symptom-free at end of 3 years (11 out of 36 cases).
19.3 per cent well and symptom-free at end of 5 years (6 out of 31 cases).

end. The response to irradiation in osteogenic sarcoma is remarkably slow. While other tumors show a response after a few weeks, the bone sarcomas may seem to be getting worse for from one to three months, and then show improvement. At this stage, we have been generally recommending amputation, but perhaps more patience would have made the amputation unnecessary. Holfelder has seen cases in which no improvement was recognized clinically until after eight to ten months. He says, "In some cases of giant cell, round cell and spindle cell sarcomas, improvement has been noticed after four weeks while in exactly similar histological cases no improvement has been noticed until after eight to ten months." The beginning of a healing process is recognized earlier by the roentgen rays and is indicated by a smooth and even deposit of calcium in the areas previously shown to be destroyed.

Theoretically, it would seem that if amputation is to be considered, preliminary irradiation is totally unnecessary and a waste of time. I can agree with this theory but the records of amputations that were made formerly and without such preliminary irradiation make a very bad showing as the Sarcoma Registry and other records will indicate. From practical observation, it seems therefore that preliminary irradiation is useful even though one decides upon operation at a later date. Based upon Holfelder's record of improvement following exacerbation of symptoms after many months, we shall feel less inclined to recommend amputation in the future.

TECHNIQUE

Holfelder recommends in a general way the following technique: "A preliminary massive dose of from 90 to 120 per cent H. E. D. in the tumor area. After from 4 to 8 days, this dose is again brought to saturation (Pfahler), and this saturation effect is repeated once or twice again, after which there should be a pause of from 2 to 4 months, and the series is then repeated."

of the portals of entry and the direction of the rays. It must not be entrusted to a technician. The necessary high dosage makes the possibility of damage very great and therefore each dose must be carefully measured and the cumulative value recorded. Even with all care, as Holfelder has stated, some damage may be unavoidable. Even the bone structure may be damaged as has been described by Regaud,

TABLE III

CASES TREATED WITH ROENTGEN RAYS AND RADIUM PACKS—BEFORE AMPUTATION—16 CASES

No. of Cases	Well	No. of Cases	Deceased
1	1 yr. after treatment	1	2 mo. after treatment
1	1½ yr. after treatment	1	6 mo. after treatment
1	2½ yr. after treatment	2	1 yr. after treatment
1	3 yr. after treatment	1	2 yr. after treatment
1	6 yr. after treatment	1	3 yr. after treatment
1	8 yr. after treatment	1	4 yr. after treatment
1	9 yr. after treatment	1	6 yr. after treatment
		1	7½ yr. after treatment
7		9	

43.7 per cent well and symptom-free.

30.7 per cent well and symptom-free at end of 3 years (4 out of 13 cases).

25.0 per cent well and symptom-free at end of 5 years or more (3 out of 12 cases).

OSTEOGENIC SARCOMA—58 CASES

37, or 63.8 per cent are males.

21, or 36.2 per cent, are females.

The average duration of time until roentgen or radium therapy was administered was 1.4 years.

Of the 58 cases of osteogenic sarcoma, 41 of these were proved by microscopical examination. The remaining 17 cases had no microscopical examination made because they were so far advanced or were hopeless.

The age incidence is of no special value. Our youngest patient was one and a half years old and our oldest seventy years of age. However, the average age was 31.5 years.

In a general way this agrees with our technique, except that we use from four to six days to bring the tumor dose to 100–120 per cent according to the location, and then we keep this 100 per cent effect in the tumor area according to the saturation curve (Pfahler) for a period of about three weeks. The preliminary course is therefore carried over a period of about a month. It is most important that the normal soft tissues, the vital organs and the general body be spared as much as is possible. This will require great care in the arrangement

Baensch, Ottow, Ewing, Groover and Christie, and others, but *Borak after reviewing all the records concludes that no normal bone has been found damaged in any of the cases unless there has been some damage to the overlying soft tissue.* Even in young persons no interference with growth has occurred unless the soft tissues were damaged or the affected extremity has been kept at rest. He reports cases to prove this point.

The following cases are of special interest not because of the therapeutic results but because of other factors concerned:

FIG. 1. Case 1. January 23, 1922—Shows the outline of the tumor tissue on the anterior surface of the thigh involving only the soft tissues.

CASE REPORTS

CASE 1. (Figs. 1, 2, 3, 4 and 5.) N. M., male, aged twenty-three, was referred to our service on January 23, 1922, by Dr. James K. Young, with a history of rheumatism in the right thigh during the Summer of 1921 and during a period of two or three weeks then noticed swelling and soreness which persisted during a period of about six months. No history of lues; Wassermann reaction negative. No special history of trauma. Worked in the storage room of the hospital, handled heavy boxes and played base ball.

At the date of our examination he had a palpable tumor apparently involving the soft tissues and about 20 cm. in length and 5 cm. in thickness. Roentgen examinations showed the outline of this tumor in the soft tissue.

On February 23, 1922, the clinical diagnosis of Dr. Young and Dr. Pfahler was sarcoma. The patient was given roentgen treatment with low voltage roentgen rays, cross-fired, four full doses over each of four fields during a period of two and a half years.

When examined on February 28, 1924, or nearly two years later, there was definite calcification scattered through this tumor area and still separated fron the bone. At that time our diagnosis was changed to myositis ossificans.

A re-examination on July 18, 1924, without further treatment, showed this calcification increased. In October, 1924, the calcification seemed to be causing irritation of the soft tissues and we advised excision, which was done by Dr. J. B. Carnett on October 17, 1924. He found no bone involvement. Roentgen examination of the femur, however, two weeks after this operation showed slight evidence of disease involving the cortex of the femur. Examination of the removed tumor microscopically at this date gave varying opinions. Dr. Eugene A. Case, pathologist at the Graduate Hospital, believed that it was an osteogenic sarcoma probably arising from the periosteum.

The case was then sent to the Registry of Bone Sarcoma, with films, record and specimen. The following letters were then received:

FIG. 2. Case 1. February 21, 1924—Shows calcification in the tumor at which time we made a diagnosis of myositis ossificans.

June 3, 1925. Letter from Dr. E. A. Codman to Dr. E. A. Case, University of Pennsylvania. Before slides came. Jan. 2, 1925. "This seems in every way typical of myositis ossificans except the pathologic report of 'many mitotic figures.' Even that I should discount and class the case as myositis until convincing pathologic slides or tissue are received. The mere gross specimen is to me pretty convincing of myositis. One cannot excise an osteogenic sarcoma in this way. I wonder if the pathologist would give us a piece of the tumor."

March, 1925. "Probably myositis ossificans." J. Ewing.

Slides arrived April 30, 1925.

May 1, 1925. "Periosteal (extraperiosteal) osteogenic sarcoma? The bone is not tumor bone. A sarcoma arising in fibrous tissue." C. L. Connor.

May 22, 1925. "Malignant leiomyoma.

Fig. 3. Case 1. July 18, 1924—Shows increased calcification of the tumor and some irritation around the tumor, supposed to be mechanical in nature.

Fig. 4. Case 1. Shows the disease in the bone which was demonstrable two weeks after the excision of the tumor.

(This without special stains, but absence of intercellular substance, numerous mitoses, presence of fibrils stained with eosin and clinical history suffice.)" S. B. Wolbach.

May 22, 1925. "My experience with general pathologic histology is not great enough to affirm or deny Dr. Wolbach's diagnosis, but I do feel that my experience with bone tumor pathology is enough to say that this is not an osteogenic sarcoma. The bone present is not like the bone formed by osteogenic sarcoma. It seems to me to be osteoid substance forming in spaces between the tumor cells. That is, I believe the deposit is chemically produced without the aid of the cells as in normal osteoblastic formation. The little trabeculae are not like normal bone or the bone produced in myositis ossificans. They seldom show cells in their centers and the cells adjacent to them do not differ from the other cells of the tumor. Some of

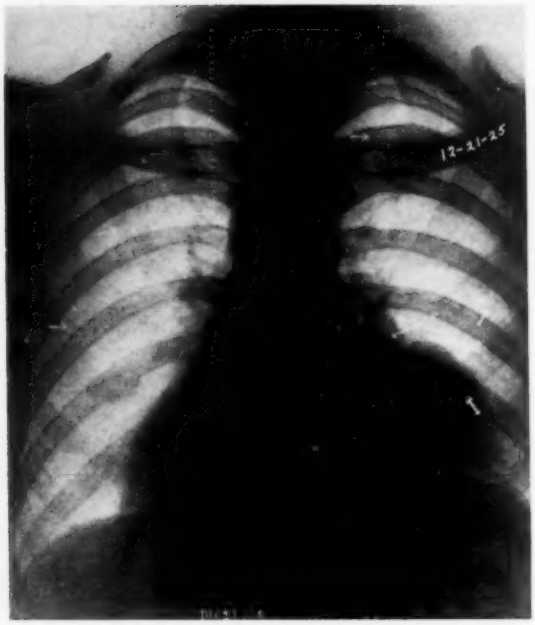


FIG. 5. Case 1. December 21, 1924—Shows the metastasis to the lungs which resulted in death of the patient on September 12, 1926.

the new bone is in necrotic areas, as if precipitated there. The clinical history of long duration, the unusual cellular structure all speak against osteogenic sarcoma. It is a most interesting case and we are going to try some more special stains for fibrils." E. A. Codman.

June 9, 1925. The patient feels well. About two weeks ago he noticed a swelling just below the right anterior superior spine of the ilium. This now is a movable tumor mass approximately 3 cm. in diameter. It seems to be a soft tissue tumor. It was decided to give high voltage roentgen treatment localized over this tumor area, beginning with an 80 per cent dose and kept at saturation for three weeks.

On June 9, 1925, the tumor showed no lime deposits by roentgen examination.

September 15, 1925. Letter to Dr. Codman. "In the case of N. M., we have just re-examined him. He has a recurrent tumor about 2 inches below Poupart's ligament, about the size of a hen's egg. It seems to involve only the soft tissues. It is not bony and contains no lime salts. It occupies the line of the outer border of the femur. I have no doubt in my own

FIGS. 6 and 7. Case II. June 29, 1921—Shows condition of the bone at the time of original examination. Treatment by irradiation, then amputation. Well for nine years.

mind but that it is malignant and we are dealing with a recurrence, in spite of your diagnosis that the case was one of myositis ossificans. I find now, too, a destructive cavity 3 cm. in length and approximately 1 cm. in width, located in the middle of the shaft on a level with the lower border of the lesser trochanter. The lesser trochanter is less dense than normal. There is slight vegetation and erosion on the inner surface of the cortex, below the lesser trochanter. I have advised excision of this tumor and further microscopical study." G. E. Pfahler.

On December 21, 1925, definite metastasis was found in the lungs and there was progressive destruction of the right femur. At this stage there could be no question about this being sarcoma involving both the soft tissues, the bone and with metastasis to the lungs.

FIG. 8. Case III. Shows an old tumor at the lower extremity of the femur with apparently a recent fracture in the tumor. October 4, 1928, beginning of treatment.

FIG. 9. Case III. A lateral view of the same tumor but showing striations extending back toward the popliteal space, which led us to think that we were dealing with sarcoma. November 24, 1928, shows more definite calcification in soft tissues.

This is probably one of the extraperiosteal osteogenic sarcomas, but it illustrates the difficulty of making a diagnosis even when the entire tumor is at hand for microscopical study.

The patient died September 12, 1926, approximately five years after the beginning of the lesion in the soft tissues.

CASE II. (Figs. 6 and 7.) S. Z. male, aged twenty, was referred to Dr. Pfahler's service by Drs. J. K. Young and M. B. Cooperman on December 4, 1921, with a probable diagnosis of osteomyelitis.

Roentgen examination showed osteogenic sarcoma involving the lower third of the shaft

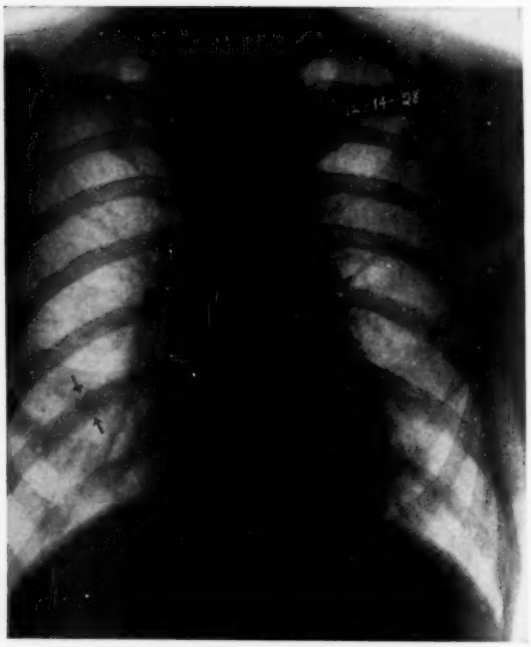


FIG. 10. Case III. December 14, 1928—Shows chest with suspicion of a lesion in the right lower lobe, which could not at that time be recognized.

of the left femur. This had been giving symptoms for one year. He was suffering from pain and swelling following an injury. He had never been operated upon.

He was treated with low voltage roentgen rays to the limit of skin tolerance and then had a disarticulation of the left femur at the hip-joint on April 7, 1921.

The diagnosis of osteogenic sarcoma was confirmed.

The patient has remained well to the present time, which is about nine and one-half years.

This is another case that might possibly have responded to the radiation alone if we had had more patience. However, we should be satisfied with the fact that he is alive and well today.

CASE III. (Figs. 8, 9, 10, 11, 12 and 13.) H. E. P., aged fifty-eight, was referred by Dr. C. Howard Moore on September 4, 1928, on account of a painful and swollen left knee, with localized tenderness suggesting either osteomyelitis or tumor formation.

This patient had a fracture of this knee treated by Dr. W. W. Keen, thirty-one years previously. He had no subsequent symptoms except that the knee was enlarged until May, 1928, at which time he was injured. Our roentgen examination on September 4, 1928, showed evidence of a cystic tumor formation in the lower extremity of the femur with the arrangement such as would have been produced by a fracture with displacement of the lower fragment forward thirty-one years previously. At the time of our examination, however, in addition to this cystic or giant cell tumor appearance in this enlarged lower extremity of the femur, there were radiations into the soft tissues which strongly suggested malignant disease. The elevation of spurs at the upper edge of the tumor area also suggested osteogenic sarcoma from a roentgen standpoint. The cortex of this cystic area was almost of egg-shell thickness at certain portions. A definite diagnosis could not be made, but it seemed probable that he had an old fracture with dislocation forward of the lower fragment and it seemed, with the cystic appearance of the bone that this condition, which gave no symptoms until he received his injury, was a local fracture of the shell of this tumor as indicated by the small arrows.

After conference with Dr. C. H. Moore it was decided to give preliminary irradiation and

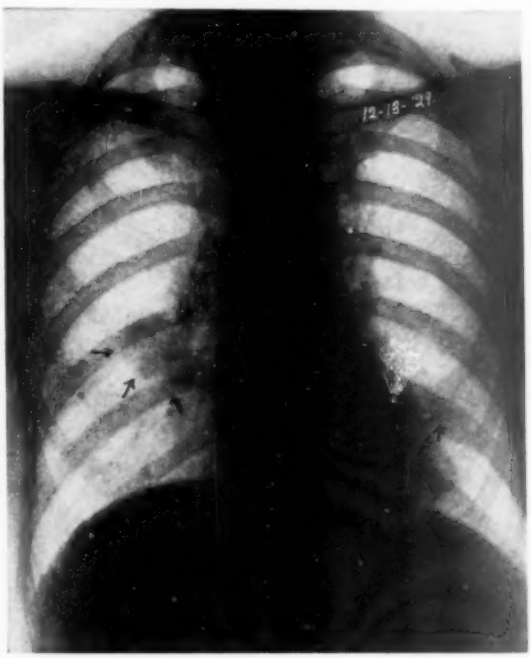


FIG. 11. Case III. December 13, 1929—Shows definite metastasis to the lungs.

then remove a section for microscopical examination.

The films were sent to Dr. E. A. Codman, who also believed that it was probably an old giant cell tumor associated with an old fracture. He said further: "(1) I do not believe there is any malignant degeneration. Exploration would do harm if there were. (2) I think it is not osteomyelitis but a mild giant cell tumor or cystic process. (3) I think the spicule-like appearances are healthy new bone formed in the lines of stress. I would advise watching and mild x-ray therapy."

Fig. 12. Case III. January 21, 1930—Shows the edges of the tumor breaking down and evidence of infiltration in the lower half of the femur. There had been an improvement both roentgenographically and clinically during approximately a year.

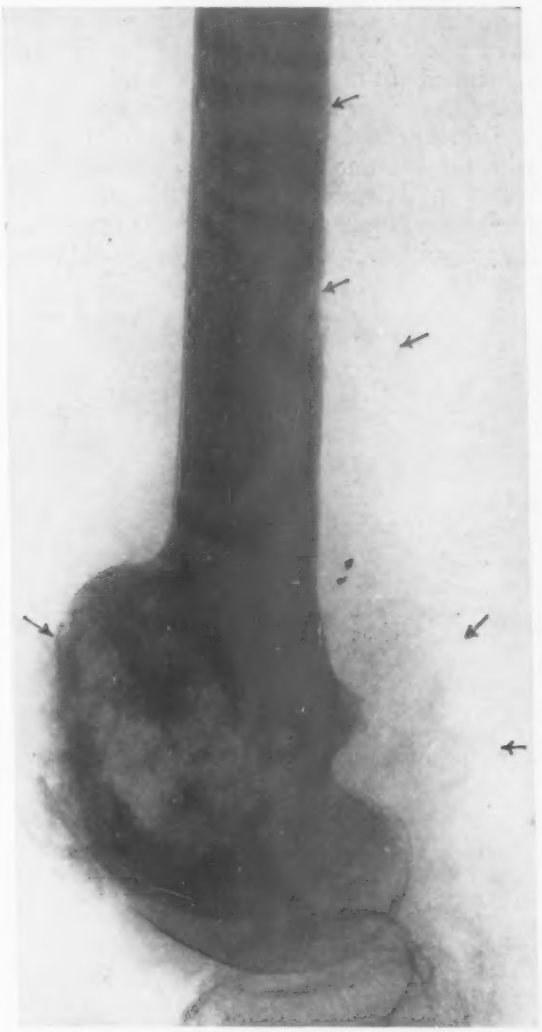


Fig. 13. Case III. Shows a lateral view with increased destruction and infiltration of the bone.

The case and records were sent to the American College of Surgeons and the following note was received from Dr. D. B. Phemister: "I have examined the x-rays and reviewed the history of Mr. H. E. P., and agree with your diagnosis of giant cell tumor, but advise operation as x-ray control of these tumors at the lower end of the femur has been unsatisfactory in my experience and in that of the registry. Curette under a constrictor for hemostasis and cauterize. Since you have had a large experience in the x-ray treatment of giant cell tumors,

I would like to know what your results have been where the lower end of the femur or the upper end of the tibia was involved."

On December 11, 1928, the films were sent and further report was made to Dr. Codman with the question as to the advisability of amputation. His reply was, "If the tumor were benign you would do more harm than good, and if you had to amputate anyway it would be on chest and a report on December 14 from Dr. Phemister states, "The new bone on the back of the femur in the case of Mr. H. E. P. certainly looks like osteogenic sarcoma."

On December 31 Dr. Crowell reported that the diagnosis of the American College of Surgeons was changed to osteogenic sarcoma.

On January 2, 1921 Dr. Ewing reported: "I agree with Codman that this case is an old

FIGS. 14 and 15. Case IV. Shows the defect in the bone resulting from the operation with the surrounding infiltration and bone deposit. Radium treatment; well over three years.

a doubtful histologic diagnosis. I should urge deciding the question on purely clinical grounds as to usefulness, pain, etc. This appearance of a rounded popliteal tumor, with rather radially arranged striations, may be interpreted in two ways only, so far as I can see. You may be correct in interpreting them as due to an osteogenic sarcoma arising in the old tumor; or, I may be correct in my guess that they represent beginning normal bone formation in an extravasated portion of the old giant cell tumor."

Roentgen examination on December 15, 1928, showed no recognizable tumor in the giant cell tumor, the fracture of long standing and a new and progressive process, mainly on the posterior side of the tumor. There is considerable irregular new growth of bone in this region. While malignant changes in old giant cell tumors are apt to occur, after many years, I do not think one is justified in assuming that this case is malignant at the present."

On December 13, 1929, a roentgen film of the chest showed definite evidence of metastasis.

The patient died of metastatic osteogenic sarcoma on February 14, 1930.

This case is important because of (1) the difficulty of making a diagnosis; (2) the long duration of some old pathological condition which gave no symptoms, and (3) the fact that this activity developed following injury.

Case IV. (Figs. 14 and 15.) R. M. W., male, aged nineteen, referred for radiation treatment

Fig. 16. Case v. Shows the condition at the beginning of treatment.

on December 27, 1926, by Drs. John H. Jopson and DeForest Willard.

During the Summer of 1925 the patient injured the right knee involving the upper extremity of the tibia. An examination after the injury was made by Dr. Manges and showed no fracture.

Roentgen examination in December, 1926, by Dr. Ralph Bromer showed a haziness involving the upper part of the tibia and after consultation with Drs. Baer and Baetjer of Baltimore it was decided that this growth was malignant. The disease involved an area about 5 cm. in diameter, involving the upper and outer portion of the tibia with an extension of osseous infiltration downward in the cortex to the extent of about 8 cm. additional. The lesion showed both destruction and new growth.

The patient was operated upon by Dr. Jopson and the sections were reported as probably malignant and then referred to Dr. James

Fig. 17. Case v. Shows the specimen in longitudinal section after removal. Well over six years.

Ewing, who made a definite diagnosis of osteogenic sarcoma.

The patient was treated with radium packs giving a total of 22,000 mg-hr. at a distance of 4 cm. and with the pack completely surrounding the leg. This treatment was given within a period of three weeks resulting in a general redness of the skin and followed by complete regeneration of the bone and no evidence of recurrence to date, which is now nearly four years.

This case is of special interest because it

was treated by means of radium packs and without amputation.

The patient refused to permit a recent examination.

CASE V. (Figs. 16 and 17.) B. J., female, aged sixteen, was referred on January 15, 1924, on account of a constant pain in her right knee extending over a period of several months. This was associated with tenderness, swelling and infiltration of the tissues.

Roentgen examination led to the following report: Examined this from three different angles just as carefully as possible. Find a destructive disease involving the inner half of upper extremity of femur extending up to joint of the outer surface but believe it does not involve the joint. It extends downward about 5.5 cm. It is not clearly outlined and invasive in character. The destruction is more marked on the surface and there is some new bone growth or at least some new growth in the soft tissue on the outside of the bone. It is most likely a periosteal sarcoma. The other possibility is gumma and while a Wassermann would probably be negative it should be made. Periosteal sarcomas are most difficult of all to get well no matter how they are treated. The only other interference that should be considered in a case like this would be amputation of the thigh, probably at the middle, even before such an operation is done or any operation is performed, or any radiation started, there should be a roentgen examination of her chest. For in this disease metastasis occurs to the lungs early and it generally causes death.

This patient, briefly, was treated by means of high voltage roentgen rays. There was a delay of approximately six months before giving treatment. The patient was then treated actively during a period of four weeks and during a period of about three weeks of this time the radiation was kept at saturation value.

The thigh was amputated at the middle third on October 20, 1924. She has remained well to date and since then has been married.

This case is of interest because of the difficulty of making a definite diagnosis in the early stages and because of the fact that she is entirely well about six and a half years later.

FIG. 18. Case VI. September 9, 1925—Shows a defect in the articular surface of the os calcis with a surrounding osseous reaction. This we believe is due to an osteogenic sarcoma.

FIG. 19. Case VI. July 10, 1930—Shows this lesion completely healed of a recurrent sarcoma the result of the irradiation. Well for five years.

CASE VI. (Figs. 18 and 19.) F. L. male, aged twenty-one, was referred on August 18, 1925, by Dr. Elmer, with the history of swelling, pain and tenderness about the right malleolus. The tumor tissue was excised and found to consist of spindle cell sarcoma.

On September 8, 1925, the following report was made: The patient now has an open ulcer about 2 by 1 cm., irregular in outline, in appearance suggesting tuberculosis but there is an area of induration and fixation of tissues extending approximately 2 cm. irregularly around this ulcer which feels like malignant disease. The roentgen films which were brought to the clinic by the patient show no evidence of disease of the bone. He was advised to have another roentgen study and to have roentgen

treatment given to the point of saturation and held there for three weeks. Patient has had three roentgen treatments equalling approximately 60 per cent and on August 25, 1925,

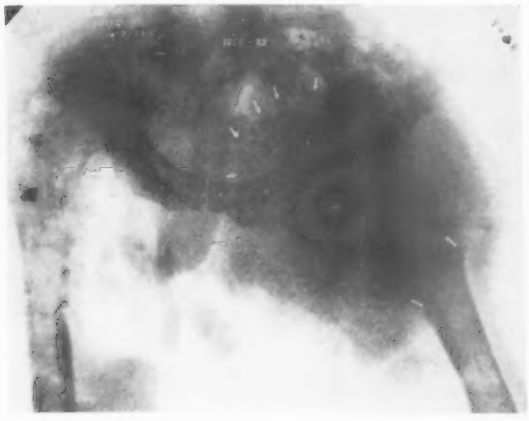


Fig. 20. Case vii. Shows a destructive disease involving the upper fifth of the femur, the inner half of the pubes and lower half of the ilium, with the tumor mass projecting into the pelvis.

probably reached the saturation point. Patient to have this dose repeated once a week during next three weeks.

Patient improved. The following notes will indicate the progress: December 29, 1925—Review of the films made preceding operation and those made September 9 and December 2, 1925, show in the original films bone reaction on the upper surface of the anterior portion of the os calcis border on the joint between the astragulus and os calcis, this bone reaction being indicated by increased density in the surrounding bone but no disease characteristic of malignant disease or of tuberculosis. The fact that the joint surface between the astragulus and os calcis is not involved would have argued against tuberculosis.

The examination made September 9, 1925, shows this bone wall more clearly but the film is of better grade which may account for the difference. There is still no destruction in the joint space.

In the films made December 2, 1925, there is still very little difference as compared with the original and with the films of September 9. In the oblique film on December 2 this bony wall is less evident and the disease on the upper surface of the os calcis is more clearly shown. There is, however, no evidence of invasion. There is evidence of bone repair relative to the cancellous lines, which are more dense. On account of this appearance the disease would not ordinarily be diagnosed as malignant, roentgenographically. The lungs show no evidence of metastasis.

On January 5, 1926, Dr. Elmer reported that a resection of the sinus was done by curetting, and microscopical study by Dr. Eugene Case showed no evidence of sarcoma or any malignancy, or anything to suggest tuberculosis.

We decided not to continue the treatment unless there was some definite indication.

Following the second operation the patient recovered and has remained completely well to date.

This case is important because the joint surface was involved. There was some reaction in the bone and it is of special interest that while the patient was referred for recurrent tumor tissue, that following the radiation treatment and subsequent resection of the discharging sinus the joint showed no evidence of disease.

Case vii. (Figs. 20, 21 and 22.) F. M., male, aged forty-two, was referred to Dr. Pfahler's service by Professor Laplace on October 9, 1922. Three years previously he developed pains in his left knee of shooting character and shortly after this developed pains in the left hip radiating down the leg. These pains grew progressively worse and during eleven months he had been unable to sleep at night without seda-

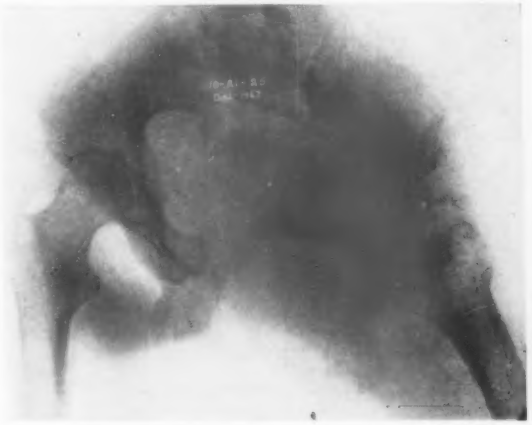


Fig. 21. Case vii. Shows the tumor mass in the pelvis sharply outlined, smooth and the tumor about half-calcified.

FIG. 22. Case VII. Shows definite progress in the destructive process of the tumor from which the patient later died.

tives. He was able to go about in a wheelchair but could not bear any weight on his left leg.

Five months previously Dr. Bird of the Samaritan Hospital had made a diagnosis of osteogenic sarcoma.

At the time of our examination he had a tumor mass involving the entire left hip with a palpable mass filling about two-thirds of the pelvic area. The tumor mass involved the entire ilium, buttocks and upper third of the thigh. At this time roentgen examination showed bone destruction and bone production involving the upper fifth of the femur, the entire head and neck of the femur and acetabular cavity. The disease involved all of the ischium and half of the pubes and the lower half of the ilium. The lime deposit and overgrowth of bone was scattered through the tumor. Diagnosis was osteochondrosarcoma and since there was nothing else to do we gave him roentgen treatment, using low voltage roentgen rays with 6 mm. Al filter, 9 inch spark gap, 40 cm. distance and 40 minutes' exposure over each area. He was treated to the limit of skin tolerance and showed progressive improvement.

Approximately two years later, March 14, 1924, the inner border of the tumor was bony and sharply defined and at this time occupied about one-third of the pelvic area. It had not extended downward or upward in the bones.

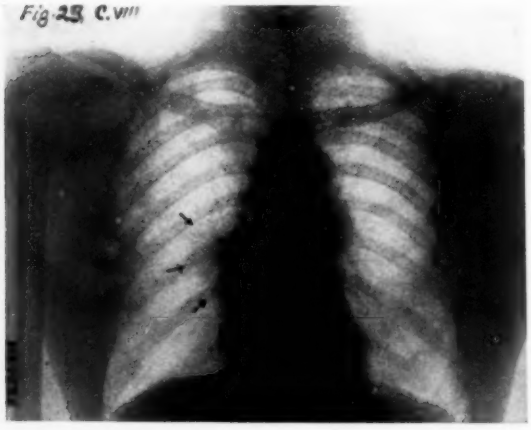


FIG. 23. Case VIII. March 11, 1930—Shows tumor mass occupying the right side of the sternum and extending into the lung tissue having the appearance of being invasive in character.

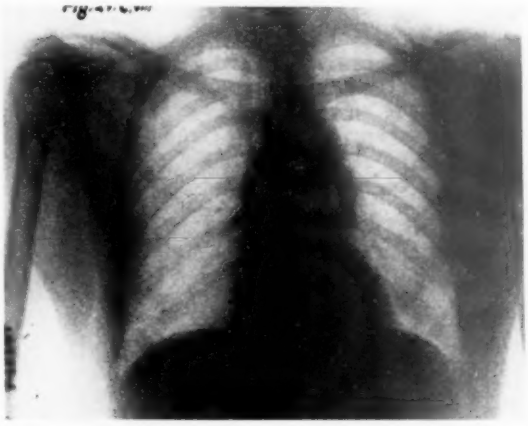


FIG. 24. Case VIII. September 6, 1930—Shows all the disease to have disappeared.

The tumor in the pelvis was almost solid bone tissue.

Before treatment he had to get up six times each night because of bladder irritation. On April 2, 1923, he did not have to get up at all. He was able to go about with a cane and took up a position as clerk in a store, which he continued until October 21, 1925, at which time there was evidence of further destruction and extension of the tumor with re-destruction of the area previously calcified. At this time the entire pubes was destroyed and two-thirds of the ilium.

He died during the Summer of 1927, or approximately five years after beginning treatment of an apparently hopeless osteochondrosarcoma.

This case is of interest because as an os-

teogenic sarcoma it has clearly been shown to involve three bones and has crossed a joint line. It is known that osteogenic sarcomas do not cross the joint line in advanced cases. This however has impressed us as a case of osteochondrosarcoma. If we we were dealing with this case today, we would take a specimen by the aspiration method and make a diagnosis, after the preliminary irradiation.

Case VIII. (Figs. 23, 24, 25, 26 and 27.) H.-M.G., aged fifty-four, referred by Dr. Leland Madden, March 11, 1930, on account of a tumor mass projecting from the sternum. The patient had complained of a swelling and pain in the region of the lower part of the sternum for nine months. There was no history of trauma.

Fig. 25. Case VIII. March 11, 1930—Shows tumor mass extending backward from the sternum, which in oblique views shows a destruction of the greater part of the gladiolus.

Fig. 26. Case VIII. March 11, 1930—Oblique view showing the destructive effect on sternal bone.

After roentgen examination, the following report was made: "I find a tumor mass approximately the size of a fist which is palpable externally making a tumor mass approximately 11 cm. in length, 7 cm. in thickness, anteroposteriorly and approximately 9 cm. laterally. This tumor mass has destroyed about three-fourths of the gladiolus. It has extended through and destroyed this portion of the sternum. It is centering over the cartilage of the third rib. On account of this destruction and on account of the invasive character shown in the anterior film extending over toward the right, I am convinced that we are dealing with malignant disease, probably a chondrosarcoma or a chondro-osteosarcoma. The lateral view shows definite lifting of the periosteum such as we see so characteristically in sarcoma. Deep roentgen therapy advised. Under this deep therapy the tumor mass has entirely disappeared and within six months the lung tissue is clear."

Roentgen examination on May 7, 1930, showed the lungs clear and the tumor tissue practically gone, but there was disease involving the upper portion of the acromial process on the left side. Under roentgen treatment this

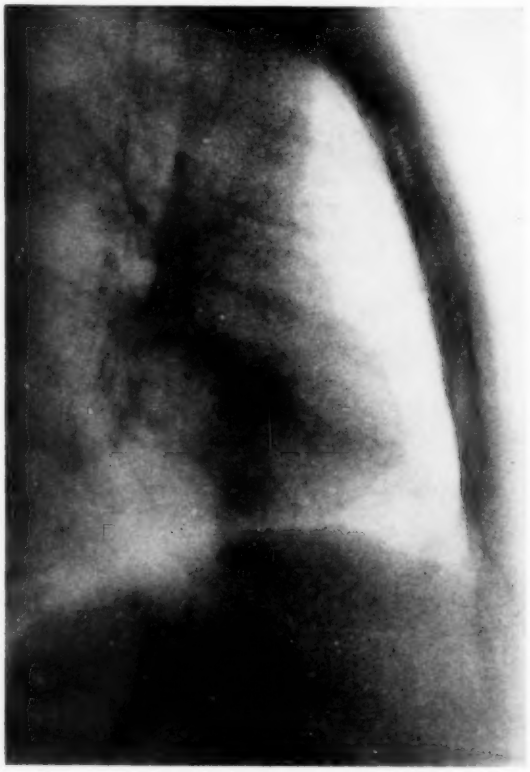


FIG. 27. Case VIII. September 6, 1930—Transverse view showing complete disappearance of the tumor.

disease disappeared and on September 6, 1930, there was a cystic appearance in the left humerus which looked like a bone cyst. This was not present in previous films. This finding casts doubt on the original diagnosis.

The patient was treated to the limit of normal skin tolerance, but on one occasion, March 28, 1930, his white blood cells had dropped to 2,700. A blood transfusion caused an improvement. The table below shows his blood record which will be of interest.

This case is of special interest because of the location of the tumor and because of the difficulty of making a diagnosis and because of the recent development in the left humerus. The patient is symptom-free at the present time.

SUMMARY AND CONCLUSIONS

Based upon a study of 58 cases of osteogenic sarcoma treated by irradiation, together with a review of similar work done in other clinics, we feel justified in concluding that the only two methods of treatment for this disease are irradiation or surgery, or the two combined.

The results from irradiation seem to be at least equally as good as, and we believe better than, those obtained by surgery alone.

Preliminary irradiation of the tumor area and irradiation of the pulmonary area followed by amputation, has given us the best results to date, but based upon Holfelder's observations, it would seem that we may not have waited long enough for the full beneficial effect of the irradiation.

A biopsy for diagnosis is desirable but should be preceded by a preliminary thorough course of irradiation by deep roentgen therapy for a month preceding the biopsy.

An accurate diagnosis is still the most important single element in the therapeutic management of osteogenic sarcoma.

Date	Hemoglobin	Red cells	White Cells	Polymorphonuclears	Small lymphocytes	Large lymphocytes	Eosinophiles
3.19.30	80	5,700,000	6,400	73	25	1	1
3.28.30	84	3,700,000	2,700	60	40		
4.11.30	80	5,000,000	5,400	62	35	1	2 (after transfusion)
4.19.30	78	5,000,000	3,000	71	29		
5.7.30	75	4,400,000	2,900	65	31		4
7.11.30	60	3,390,000	4,100	58	38	19	
9.8.30	85	4,110,000	3,350	70	25	4	

REFERENCES

ABBÉ, ROBERT. Die Anwendung von Radium bei Karzinom und Sarkom. *Strahlentherapie*, 1914, *4*, 27–35.

BAENSCH, W. Ueber die Grenzen der Röntgentherapie chirurgischer Erkrankungen. *Strahlentherapie*, 1924, *18*, 517–535.

BAENSCH, W. Knochenschädigung nach Röntgenbestrahlung. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, *36*, 1245–1247.

BORAK, J. Röntgenbehandlung metastatischer Knochengeschwülste. *Arch. f. klin. Chir.*, 1926, *143*, 185–199.

BORAK, J. Röntgentherapie bei Knochengeschwülsten. *Strahlentherapie*, 1929, *33*, 435–455.

BORAK, J., and DRIAK, F. Melanosarcomas, treated by roentgen rays; biology of action of rays. *Strahlentherapie*, 1926, *21*, 550–560.

CODMAN, E. A. Nomenclature used by registry of bone sarcoma. AM. J. ROENTGENOL. & RAD. THERAPY, 1925, *13*, 105–126.

CODMAN, E. A. Registry of bone sarcoma. *Surg., Gynec. & Onst.*, 1926, *42*, 381–393.

COENEN, H. Das Basalfibroid (typisches Nasenrachenfibrom) ein Skelettumor. *München. med. Wchnschr.*, 1923, *70*, 829–833.

EVANS, WM. A., and LEUCUTIA, T. The value of roentgen-ray therapy in primary malignant tumors and benign giant cell tumor of bone. AM. J. ROENTGENOL. & RAD. THERAPY, 1928, *20*, 303–338.

EWING, JAMES. Radiation osteitis. *Acta radiol.*, 1926, *6*, 399–412.

FUKASE, S. Ueber die Beeinflussung der Frakturheilung durch Röntgenstrahlen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1930, *41*, 581–588.

HENSCHEN, G. E. Report of case of bone sarcoma treated by x-ray. *Texas State J. Med.*, 1929, *24*, 852–853.

HERENDEEN, R. E. Changes in primary and metastatic bone tumors following various doses of roentgen ray. *Radiology*, 1929, *13*, 326–337.

HOLFELDER, H. Die Röntgentherapie der Sarkome. *Med. Klin.*, 1921, *17*, 1456–1457.

HOLFELDER, H. Die Erfahrungen mit der Röntgentherapie der malignen Tumoren an der Schmiedenschen Klinik. *Strahlentherapie*, 1923, *15*, 715–731.

HOLFELDER, H. Röntgentherapie chirurg. Erkrankungen. In Krauses Handbuch der Röntgentherapie, 1924.

HOLFELDER, H. Die Röntgenbehandlung der malignen Geschwülste. *Ztschr. f. ärztl. Fortbild.*, 1924.

HOLZKNECHT, G. Vortrage über Röntgentherapie. Urban and Schwarzenberg, 1925.

HUECK, H. Zur Strahlenbehandlung der Sarkome. *Arch. f. klin. Chir.*, 1926, *139*, 607–615.

JÜNGLING, O. Zur Behandlung der Sarkoms mit Röntgenstrahlen. *Strahlentherapie*, 1921, *12*, 178–202.

JÜNGLING, O. Röntgenbehandlung chirurgischer Krankheiten. S. Hirzel, Leipzig, 1924.

KAESTLE. Röntgentherapie der Knochen- und Gelenkserkrankungen. Rieder-Rosenthals Lehrbuch, 1922, III.

KÖHLER, A. Einiges zur Frage der Tumorbehandlung mit Röntgenstrahlen. *München. med. Wchnschr.*, 1921, *68*, 1322.

KOLODNY, ANATOLE. Bone sarcoma. The primary malignant tumors of bone and the giant cell tumor. *Surg., Gynec. & Obst.*, 1927, *44*, *Suppl. 1*, 1–214.

KROGIUS, A. Ueber einen mit Röntgen-Strahlen erfolgreich behandelten Fall von Schädelsarkom. *Arch. f. klin. Chir.*, 1903–1904, *71*, 97–110.

LEDOUX-LEBARD, R., and PIOT, E. Deux cas de sarcome de l'os iliaque traités par la radiothérapie pénétrante. *J. de radiol. et d'électrol.*, 1927, *11*, 424–428.

LENK, R. Bestrahlung eines Falles von Lungensarkommetastasen. *Wien. klin. Wchnschr.*, 1924, No. 45.

MARTIN, H. E., and ELLIS, E. B. Biopsy by needle puncture and aspiration. *Ann. Surg.*, 1930, *92*, 169–181.

PERTHES. Ueber die Strahlenbehandlung bösartiger Geschwülste. *Arch. f. klin. Chir.*, 1921, *116*, 353–370.

PETERSEN, O. H. Zur Frage der Dauerheilungen von Sarkomen durch Röntgenstrahlen. *Strahlentherapie*, 1913, *3*, 490–507.

PFAHLER, G. E. The treatment of sarcoma by means of the roentgen rays. *N. York M. J.*, 1907.

PFAHLER, G. E. The roentgen treatment of metastatic carcinoma of bone. *Acta radiol.*, 1926, *7*, 280–288.

PIOT, E. La roentgentherapie des osteosarcomes. *Progrès méd.*, 1927, *42*, 896.

RIEDER, H. Zur Röntgentherapie der bösartigen Neubildungen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1914–1915, *22*, 405–411.

SEVERLEIN, and HÖLZEL. Zur Sarkombehandlung. *Beitr. z. klin. Chir.*, 1923, *128*, 590–604.

SOILAND, A., and COSTOLOW, W. E. Radiation in the treatment of bone tumors. *Radiology*, 1926, *7*, 36–38.

TAVERNIER, L. Le traitement radiothérapique des ostéosarcomes. *Cancer, Bruxelles*, 1929, *6*, 113–133.

TAVERNIER, L. Dix cas d'ostéosarcomes des membres traités par la radiothérapie. *Lyon chir.*, 1929, *26*, 812–818.

VALLEBONA, A. La roentgen e la radiumterapia dei tumori delle ossa. *Radiol. med.*, 1929, *16*, 190–216.

WETTERER, J. Die Strahlenbehandlung der bösartigen Geschwülste. *Strahlentherapie*, 1920, *10*, 758–797.

WETTERER, J. Handbuch der Radiotherapie, 1924.

DISCUSSION

DR. WILLIAM A. EVANS, Detroit, Mich. I am called upon to discuss this paper without an opportunity of referring to my records, so my remarks of necessity will be of a general character. While Dr. Pfahler does not agree with me that it is dangerous to treat malignant melanomas by the electrocoagulation method, I shall find no objection to the conclusions drawn by Dr. Pfahler in his paper. Every roentgen therapist should be in complete agreement with Dr. Pfahler, because he has been a leader in the progress of this branch of our science.

While our experience has extended over a briefer period and our series is not so extensive as Dr. Pfahler's, we have tried diligently to treat these conditions, cooperating faithfully with the Registry of Bone Sarcoma of the American College of Surgeons. We have reported some 60 cases and continue to keep the Registry informed as to the condition of the surviving cases, and our experience in this group is such that we believe little reliance can be placed on sarcoma statistics. Often the Committee finds it necessary to change their original diagnosis, even after a period of years. Only a few weeks ago they reversed themselves on 2 cases they had previously listed as osteogenic sarcoma, and, as I state, figures on sarcoma cures must not be taken too seriously.

Also, our experience with pathological reports makes us doubt seriously the value of biopsy. Furthermore, we have had the misfortune of having had 2 of our cases infected by this procedure. Both of the cases had serious complications associated with the infection of the tumor, secondary to the biopsy. Many pathologists insist that the burden of the diagnosis of bone tumors is the roentgenologist's and not the pathologist's.

We believe that the prognosis depends somewhat upon the bone involved. In those cases in our series in which the tumors arose from the small bones, such as the fibula and clavicle, our results have been very satisfactory. We have observed that the tumors which arise from the lower ends of the femora give us the greatest difficulty. It is our experience that following the radiation treatment there is so much reaction that the pain becomes so severe that amputation is necessary to obtain relief.

We had, in our first 3 cases of sarcoma of the lower end of the femur, complete failures, so that we later adopted the plan of treating the lesion locally and then treating the possible extensions, especially the chest, and by this method we were able to carry 2 cases beyond the four year period.

For the past three or four years we have believed that our results have been improved by the use of intravenous lead, using the preparation furnished by Santa Barbara Cottage Hospital. In all of our bone and lung cases, whether the bone cases represent primary or secondary malignancy, we use this method and we advocate it, believing that our results are better. The results obtained by irradiation justify the use of this form of treatment for every type of malignant bone tumor.

DR. JOHN T. MURPHY, Toledo, Ohio. I want to thank Dr. Pfahler for this paper. In the one case that he showed which resembled giant cell tumor, I would like to call attention to one point that may help in diagnosis. We all realize that in differential diagnosis of the lymphomata, the therapeutic test of roentgen radiation is one you can depend upon. In the giant cell tumor case, apparent giant cell tumor, if that case was treated with the ordinary technique for giant cell tumor and did not respond after a reasonable length of time, as a giant cell tumor will, one must suspect that it is not a giant cell tumor. I had the same experience once in treating such a case that turned out to be an osteogenic sarcoma.

For metastasis of these osteogenic sarcomas we usually look at the chest and the parts far from the tumor.

The case I want to show is just one of giant cell tumor. I also want to ask a question. (Shows slides.)

The question I want to ask is this: Here is a man who has been perfectly well, attending to his job since the early part of 1925. Just when is a giant cell tumor cured? May I consider this case not apt to have a recurrence when there is an area such as this which has persisted during the entire time of treatment? In the original plates you could easily see the bone is not formed in this area and it seemed to be a potential source of a restarting of the tumor, although this man has remained perfectly well now for a period of over six years.

Can anyone give me any data as to when you shall discontinue treatment or will continued

treatment produce such areas as this by breaking down the bone formation?

Dr. Pfahler (closing). Answering Dr. Murphy's question, I have discussed that question in the paper. There is difficulty in deciding when one should discontinue the treatment, providing we have started treatment and have an osteogenic sarcoma, Holfelder has discussed that subject very ably and he has on record cases that showed no response until eight or ten months after beginning treatment and then subsequently got well.

With regard to giant cell tumors in the young, we will probably see improvement at the end of a month, I mean roentgenographically, beginning with the deposit of lime along the walls of the tumor. In older persons that deposit comes more slowly, but even in the young person it is relatively slow. I think I was the first to place on record one of these cases. At that time I placed it on record as a sarcoma because the microscopical diagnosis from a biopsy was round cell sarcoma. We know now very well that this case was a giant cell tumor of the tibia. That patient I have followed for twenty-two years. There was progressive deposit and regeneration of bone during that entire time but the treatment on that case was stopped at the end of three months.

With regard to the case like the one shown by Dr. Murphy, I believe that we still have acute tumor tissue in that one part of the bone, and I believe that part of the bone should receive some treatment, not an excessive amount. I believe that we need not have fear of treatting with small or moderate doses when we are dealing with giant cell tumors.

I believe, too, that a giant cell tumor in some cases can change to an osteogenic sarcoma.

THE PROTRACTED FRACTIONAL METHOD OF ROENTGEN THERAPY (Coutard)*

By A. ZUPPINGER

From the Roentgen Institute of the University of Zurich (Director, Prof. Dr. H. R. Schinz)
ZURICH, SWITZERLAND

THE present treatment of malignant tumors, where not merely palliative, consists either of surgery or radiation therapy. In some forms surgery is the method of choice, as in tumors of the stomach or of the intestinal tract, etc.; in others, the superiority of radiation therapy is today recognized, for instance in tumors of the tongue, of the uterus, etc. There are still other forms where neither surgery nor radiotherapy has hitherto been satisfactory as, for example, in tumors of the hypopharynx.

Radiotherapy, like surgery, is a nonspecific local method. It does not remove the tumor with the surrounding healthy tissue as surgery does, but it is intended to destroy the tumor cells with the greatest possible preservation of the healthy tissue. Radiotherapy is based on the differences in sensitivity of the cells, the cells of many malignant tumors being sensitive, while the cells of the surrounding connective tissue are much less sensitive.

There are many different procedures of radiation therapy. They are schematically outlined in Figure 1. We can attempt to destroy the tumor cells with one large dose. This procedure is today the best for small carcinomas of the skin, either by roentgen or radium radiation. The method was introduced by Perthes, Regaud and Nogier, Gunsett, Brock, McKee and Miescher. The dose consists in from two to two and a half times an erythema dose. In the sketch the black rectangle passes over the two parallel lines. These parallel lines represent the erythema dose (Fig. 1, I, a, 1).

When the field is greater than 5 cm. in diameter and the irradiation is carried out with such large doses, the danger of injury to the skin is considerable. First an erythema dose is given and after the skin reaction has subsided the same dose is repeated after an interval of one and a half to two and a half months (Fig. 1, I, a, 2). Wintz and others use this procedure in irradiating cancer of the breast. Our results with this method have been unsatisfactory.

If a tumor is in the interior of the body, we then choose another method, which consists in regularly irradiating several concentric fields with an erythema dose or almost an erythema dose. We can irradiate all the fields in one day (Fig. 1, I, b, 1) but now this is rarely done because of the great general reaction. Therefore we irradiate one field each day and repeat the series in an interval of one and a half to two and a half months (Fig. 1, I, b, 2). This method of irradiation is used by various radiologists today for instance in treating cancer of the uterus.

Based on other ideas, Pfahler uses the "saturation method." He attempts to keep a constant dose of radiation in the tissue during about a fortnight by giving a full or nearly a full erythema dose in the beginning and during the following days adding the loss caused by the recovering of the tissue (Fig. 1, II). We have had no experience with this method.

Another type of irradiation is the method of fractional doses. This has the advantage that the normal skin tolerates larger doses then if the irradiation is carried out with one single dose.

A part of the erythema dose may be given at intervals of several days to weeks (Fig. 1, III, 1). This is the best method for treating inflammatory processes such as tuberculosis, lymphoma and many other conditions; it does not give good results in the treatment of malignant tumors.

Another variation of the fractional method is the daily application of a part of

* Read before the Interstate Post Graduate Assembly of North America in Zurich, June 25, 1930.

the erythema dose with the ordinary technique (Fig. 1, III, 2). This method is used in treating malignant tumors and gives better results than irradiation with one large dose.

ployed the method in roentgen therapy. It will be explained later.

The fourth method consists in the continuous irradiation during several days with

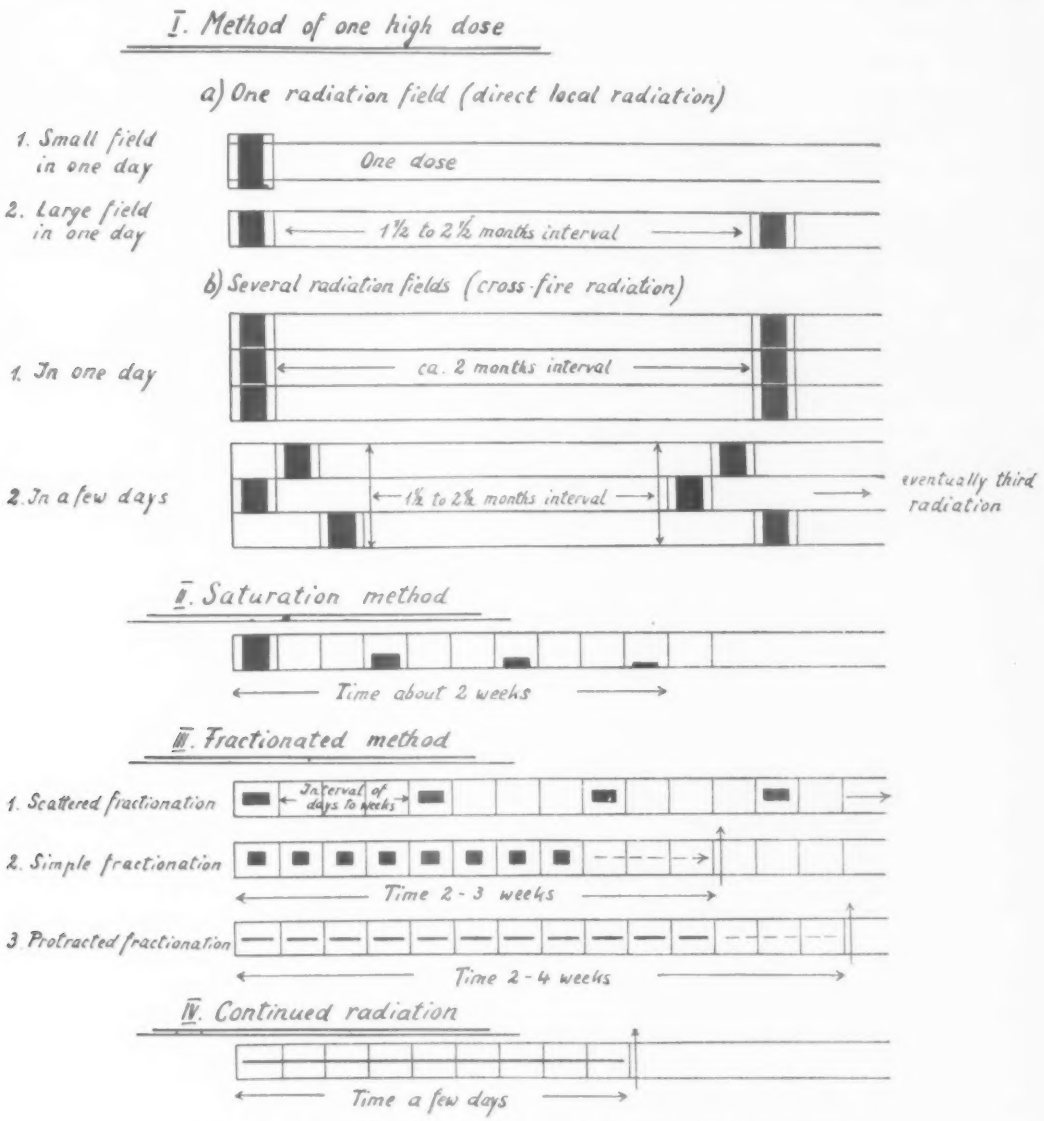

I. Method of one high dose
a) One radiation field (direct local radiation)
1. Small field in one day
One dose
2. Large field in one day
1½ to 2½ months interval
b) Several radiation fields (cross-fire radiation)
1. In one day
ca. 2 months interval
2. In a few days
1½ to 2½ months interval
eventually third radiation
II. Saturation method
Time about 2 weeks
III. Fractionated method
1. Scattered fractionation
Interval of days to weeks
2. Simple fractionation
Time 2 - 3 weeks
3. Protracted fractionation
Time 2 - 4 weeks
IV. Continued radiation
Time a few days

Fig. 1. Schematic comparison of typical methods of irradiation.

A further possibility is the daily administration of about one-third of an erythema dose with radiation of small intensity (Fig. 1, III, 3). This method is employed in the treatment of glandular metastases with a radium "moulage." During a period of about a week the patient is irradiated every day for several hours. Coutard first em-

doses of small intensity (Fig. 1, IV). It is the method of choice in the radium irradiation of tumors of the tongue and of the uterus. It was introduced by Regaud after he had proved by animal experiments that this method had a much greater sterilization effect on the testicle than a large dose given in a short time. The success of this

treatment is well known, as it is universally employed.

In many cases the use of radium is inadvisable, as, for example in very large tumors or when they are located in certain regions of the body such as the larynx or hypopharynx where there is danger of necrosis of the cartilage. In such cases, roentgen radiation is of greater help when certain precautions are observed. Coutard has

FIG. 2. Exudative skin reaction thirty days after the beginning of treatment. Surface dose of 6.5 S.E.D. over a period of twenty days, 16 irradiations for a total of twenty hours. Three days later the extensive erosions were healed.

introduced the protracted fractional method, as we shall call it, which consists of small daily doses of small intensity. The method has the great advantage that the skin, and especially the connective tissue, is much better preserved than by the usual technique. Also in histological investigations Miescher was able to show that by this method the connective tissue is less damaged than by other methods. There are two reasons for this: first, the fractionating and, second, the protracting, i.e., radiation with doses of small intensity. In contrast to the reaction of the connective tissue, the epidermis and the mucous epithelium show, as does the tumor, a much slower rate of recovery, they cumulate much better. The difference in the effect of the scattering doses on the reaction of tumor and connective tissue is thus the essential factor when the total dose is fractionated and protracted. The much better results seem to prove these contentions.

We have used this method for more than a year and the principal points will be explained and illustrated by a few examples.

The principle of the method is that the tumor is irradiated with as large a dose and in as short a time as possible. In order to protect the connective tissue the single doses are small and of small intensity. Every day for three or four weeks the diseased area is irradiated from one or, if possible, from two or more sides with a single dose of about 180 r (30 per cent of the skin erythema dose). The radiation is produced by a tension of 170–200 kv. effective, with 3 ma., filtered through 1.5 to 2 mm. copper or zinc. The half-value layer is 1.2 to 1.5 mm. copper. The distance from the tube to the skin is between 60 to 100 cm. and is so arranged that the single dose will be reached in from one to two hours. The main field is irradiated in three to four weeks with 5 to 6 erythema doses.* If this dose were applied in one sitting, it would give a very bad reaction. Of course, the protracted fractional dose also gives an intense reaction of the skin and the mucous membrane, but this is reversible. The criterion for the total dose depends on the condition of the skin and the mucous membrane. When we irradiate tumors of the pharynx or larynx we cannot expect a total disappearance of the tumor unless the irradiation is strong enough to cause a marked fibrinous reaction of the mucous membrane. The reaction usually begins on the twelfth

* The erythema dose here is understood as a unit. The biological reaction is different in this case than by irradiation with one large dose.

to the fourteenth day of treatment with reddening and increasing difficulty in swallowing. In the next few days there first appear delicate white fibrinous membranes which afterwards become confluent and soon totally cover the pharynx. The appearance of this strong fibrinous reaction is an indication that the irradiation must be stopped because further exposure would lead to necrosis of the cartilage. We once saw in a case of extremely high sensitivity a cartilage necrosis of the larynx by not observing this rule. The reaction lasts from several days to a maximum of two weeks. When the pain is very severe we prescribe codeinum phosphoricum and ordinary cream. In this way the patient can drink and take liquid food. The recovery from this reaction of the mucous membrane is always complete. Regaud, Nogier and Coutard call it radio-epithelitis to emphasize its superficial nature. In some cases a second reaction may be observed, the patient being hoarse for a few days. On inspection of the larynx a slight edema can be seen. This second reaction has always been harmless.

The reaction of the outer skin begins at the time of the appearance of the reaction of the mucous membrane and consists in a very slight reddening. In the following days epilation appears, the reddening becoming more pronounced, then the irradiated field turns brown and finally the epidermis desquamates in the form of dry scales, or large lamellae or with the formation of large exudating erosions. This depends upon the total dose, the fractionating, and the individual sensitivity. The intense skin reaction appears, as a rule, in the fourth week. It may disappear in a few days or last up to three weeks. The reaction of the outer skin seems alarming to those who have never seen it (Fig. 2); it is most surprising to find how quickly the skin heals. The epithelization proceeds from remaining islands of epithelium. When the dose on the surface of the skin does not exceed 6 erythema doses (calculated after the curves of Jacobi and Liechti), the recovery of the skin is usually complete, even the hair grows out again. In using these curves it is only necessary to measure the intensity in air and the doses on the skin can be read off. These curves give the relation between the size of the field and the number of r, measured in air, which are necessary for an erythema

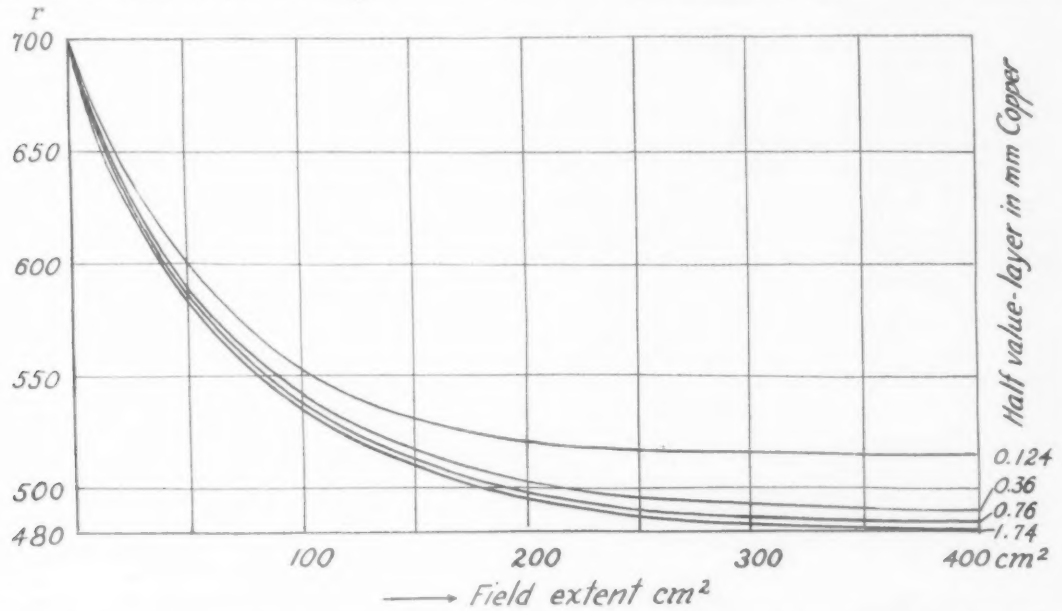


Fig. 3. Showing the number of r-units necessary for an erythema dose in relation to size of field and half-value layer in millimeters of copper.

dose. The curves of Jacobi and Liechti, which we use for the calculation of the surface dose, are shown in Figure 3.

The tumor starts to get smaller shortly after beginning of treatment. At first it is always covered with superficial necrosis, then it disappears into the general mucous membrane covering. The decrease in size continues during the month following the irradiation and in many cases the tumor entirely disappears.

The following three cases are examples of the treatment:

CASE I. A man aged sixty-seven with a large tumor of the left side of the mesopharynx extending from the plica pharyngo-epiglottica to the inferior pole of the tonsil (Fig. 4). No metastases were palpable. Histologically it was a cornified squamous cell epithelioma. Irradiation from March 28, to April 26, 1930, with a total dose of 5,400 r (measured in air) in sixty-four hours of irradiation. The left field received a surface dose of 6 erythema doses (3,200 r)* in 19 irradiations and forty hours, the anterior field 1.5 S.E.D. (850 r) in 8 irradiations and twenty hours. The tumor disappeared completely and the patient has been symptom-free for two months since the conclusion of the irradiation.

* The numbers in parenthesis signify the dose in r measured in air.

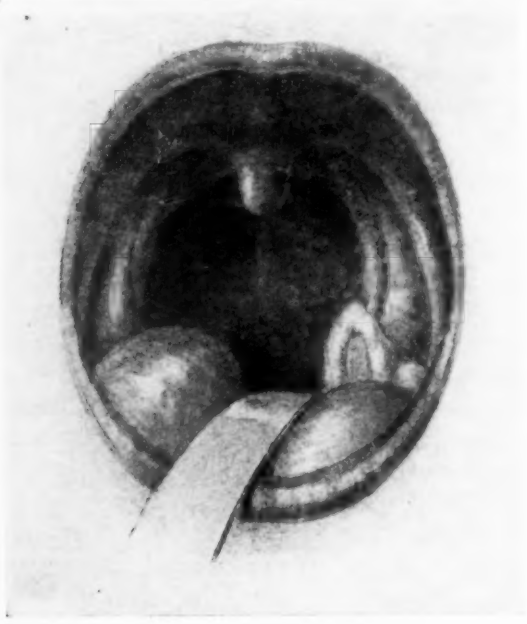


FIG. 4. Cornified squamous cell epithelioma of the left side of the mesopharynx. Showing condition at the beginning of treatment.

CASE II. A patient, aged seventy-five, with cancer of the sinus piriformis. No metastasis. Histologically cornified squamous cell epithelioma. Irradiation from July 2 to July 26, 1929, with a total dose of 7,870 r in forty-one hours of irradiation. The left field received a surface dose of 6.7 S.E.D. (3,650 r) in 19 irradiations and nineteen hours, the anterior field 5.3 S.E.D. (3,070 r) in 16 irradiations and sixteen hours, and the right field 2.1 S.E.D. (1,150 r) in 6 irradiations and six hours. Typical mucous membrane and skin reactions followed. The examination by Prof. Nager showed no sign of recurrence eleven months after treatment and only a slight edema of the right arytenoid region. The patient is locally symptom-free. The doses were perhaps too large in this case, especially in view of the long intense mucous membrane reaction which lasted for three weeks.

CASE III. A man, aged fifty-seven, with cancer of the right vocal cord (operable only by total laryngectomy). No metastasis. Histologically cornified squamous cell epithelioma. Irradiation from June 3 to June 25, 1929, with a total dose of 6,900 r in thirty-six hours of irradiation. The right field received 5.5 S.E.D. (2,880 r) in 15 irradiations and fifteen hours, the anterior field 3.9 S.E.D. (2,300 r) in 12 irradiations and twelve hours, the left field 1.84 S.E.D. (960 r) in 5 irradiations and five hours, the posterior field 1.6 S.E.D. (760 r) in 4 irradiations and four hours. The inspection of the larynx by Prof. Nager showed nothing pathological one year after treatment. The voice is absolutely clear.

The tumor regression is not always complete. Tumor rests which do not disappear in one and a half to two months after the treatment always remain. If a tumor rest is recognized it must be treated within two months after roentgen treatment, for sooner or later it will begin to grow and will spread very quickly in the tissue which has been damaged by the radiation. The prognosis is bad when the tumor rest is large. In such a case the only thing possible is to repeat the treatment with roentgen rays as before. If

Fig. 5. Cornified squamous cell epithelioma of the right cheek. Showing condition at the beginning of treatment.

Fig. 6. The same patient shown in Figure 5 one month after treatment. The teeth were extracted. The tumor rest was excised with an endothermic knife.

the tumor rest is small, it can be handled with radium needles or by electrocoagulation. The following case is an example:

Case iv. A patient forty-seven years old with cancer of the right cheek (Fig. 5). The patient also had metastases to the lymph glands. He was treated in nineteen days with a total dose of 5,120 r in sixty-four hours of irradiation. The right field received 6.25 S.E.D. (3,200 r) in 16 irradiations and forty hours, the left field 3.5 S.E.D. (920 r) in 12 irradiations and twenty hours. In the following month the cancer regressed leaving a small ulcer in the angle between the cheek and the jaw (Fig. 6). Six weeks after the roentgen treatment the ulcer was excised with an endothermic knife by Prof. Nager. For six months the patient has had no more trouble. The tumor is no longer to be seen and the lymph glands have disappeared. Because of the coagulation the patient is unable to open his mouth fully. In spite of this he has gained 26½ pounds.

A recurrence may occur with in a few months after complete clinical recovery. It seems that the later the recurrence appears, the slower it grows. It must be treated according to the same principles as the tumor rest. The following case is an example:

Case v. A man aged seventy, with a cancer of the right tonsil (Fig. 7). Histologically cornified squamous cell epithelioma. He was treated from May 22 to June 8, 1929, with a total dose of 5,370 r in twenty-eight hours of irradiation, applied to 4 fields. The right cheek-neck field was irradiated with 5.6 S.E.D. (2,820 r) in 15 irradiations and fifteen hours, the anterior field with 2.0 S.E.D. (1,150 r) in 6 irradiations and six hours, the left field with 1.9 S.E.D. (960 r) in 5 irradiations and five hours, the posterior field with 0.7 S.E.D. (380 r) in 2 irradiations and two hours. Twenty-one days after treatment the tumor had completely disappeared and all that remained was a white scar on the mucous membrane. Five and a half months after treatment there was a recurrent node the size of a pea with a central ulcer (Fig. 8). This was excised with an endothermic knife after electrocoagulation by Dr. Schurch. Since then six months have passed and the patient is locally symptom-free. For the last fourteen days a glandular metastasis has been palpable which will be removed surgically.

FIG. 7. Cornified squamous cell epithelioma of the right tonsil. Showing condition at the beginning of treatment.

FIG. 8. Small recurrence five and a half months after roentgen treatment which was electrocoagulated and excised with an endothermic knife.

The treatment of a tumor rest or recurrence is relatively simple when the tumor rest is small and easy to reach.

Recurrences or tumor rests of the base of the tongue in the deep part of the mesopharynx and in the hypopharynx are much more difficult to treat. Only small tumors can be treated by radium or by electrocoagulation. Radium treatment is dangerous because the tissue has already been irradiated, and on account of the proximity of the cartilage which may lead to necrosis. Electrocoagulation, on the other hand, is dangerous because of aspiration pneumonia. In the mesopharynx we prefer the latter method. In operating we ligate the external carotid if the tumor is very extensive. We then split the cheek, coagulate the tumor, excise it with the endothermic knife and if possible make a primary suture. Tumor rests of the hypopharynx are much more difficult to treat; as yet we have been unable to remove them by operation. The danger of aspiration pneumonia is even greater here. In a small tumor rest with good chance of complete excision, the method of Réthi may be used. This consists in preliminary suture of the vocal cord, the tumor being removed by subhyoid pharyngotomy. When the wound in the mesopharynx or hypopharynx is healed, the normal airpassage is re-established by a third operation. Small tumor rests of the larynx may be treated by laryngeal fissure.

The patient must be observed weekly for the first two months after irradiation, fortnightly for the next two months, monthly for the next three months and at longer intervals thereafter. The weight curve is a good criterion for the prognosis.

The tumors which do not lie on the surface of the body but underneath the surface, are treated in a similar manner. The regression of such a tumor takes a longer time, usually about two to three months.

We have used this method also for the treatment of inoperable cancers of the breast, of the upper jaw, and of many other types of tumors. The following is an illustrative case:

CASE VI. A girl, aged twenty-two, who two years previously was operated on because of a

Fig. 9. Retrobulbar metastasis two years after radical operation of a hemangio-endothelioma of the left breast. Showing the condition before treatment.

Fig. 10. The same patient as shown in Figure 9 two months after treatment. The exophthalmos has disappeared.

hemangio-endothelioma of the left breast came to us with a retrobulbar metastasis. She was irradiated from July 22 to August 26, 1929, with a total dose of 6,140 r in thirty-two hours of irradiation. The frontal field received 5.9 S.E.D. (3,450 r) in 17 irradiations and seventeen hours and the temporal field 4.6 S.E.D. (2,690 r) in 15 irradiations and fifteen hours. Figure 9 shows the unilateral exophthalmos and Figure 10 the patient two months after treatment. The exophthalmos has disappeared and the patient is now well a year after treatment. Even the skin looks entirely normal.

In some cases there remains a palpable resistance. Often we cannot say whether it is due to tumor tissue or not. Several times we have recommended operation and have found no tumor but a homogeneous mass consisting of amyloid, calcifications, fat cells and detritus.

By following the above rules the dangers of the method are not great.

The skin reaction may be very intense but it heals as a rule in a short time, indicating the superficial nature of the lesion. In most instances the skin becomes normal within a few months, no changes whatever being seen after about half a year. The hairs grow out again and even the secretion of the sweat glands reappears. The cases which have been operated on have afterwards shown normal wound healing without complications in the postoperative period which might be attributed to the effect of the irradiation. Sometimes when the dose amounts to a surface dose of about 7 or more erythema doses, telangiectases with slight abnormalities of pigmentation may appear later. We have never seen an ulceration and Coutard, who has patients living from five to eight years and more after treatment, has likewise never observed such complications.

It is dangerous to irradiate an inflamed

skin. We have seen twice marked telangiectasis following irradiation of such a skin, but without more serious consequences.

Late complications of the mucous membranes have never been observed after the use of this method. There is little danger of acute edema of the larynx during the treatment, whereas the late edema or the necrosis of the cartilage can be avoided by making it a rule to stop the irradiation as soon as an intense fibrinous reaction of the mucous membrane develops.

The radiation necrosis of the bone, especially of the jaw, in cancer of the tonsil or the base of the tongue can be prevented with absolute certainty. The bone necrosis is especially dangerous when it is infected. We have never seen such a complication, but Coutard has observed two cases, both following tooth extraction. In order to avoid such complications and more especially an infected bone necrosis we have the dental surgeon examine the teeth and in case of infection extract those which lie in the path of the rays.

Coutard has also observed cardiovascular disorders following irradiation of great fields of the neck. These are an indication for interruption of the treatment, although we have never observed them.

There are some other inconveniences such as disturbed salivation and diminution of the sensation of taste, but these are of only temporary duration.

The cases mentioned above represent good results. It would be possible to include other symptom-free cases but the time of observation is still too short to consider them "healed."

In contradistinction to these cases, there is a greater number of poor results. In some the tumor regressed too little, in others the tumor rest was not treated at the proper time, due chiefly to refusal of the patients to submit to further treatment because of lack of symptoms. The tumor rest eventually started to grow and the patients died either from the progression of the tumor or from the operation. In another group although locally symptom-free, death resulted later from metastases to other parts of the body. This is true especially of the cases of cancer of the hypopharynx. It must be conceded, however, that by using the right technique, many of these cancers of the hypopharynx can be made at least locally symptom-free, the palliation often lasting for a longer time.

In conclusion, we would like to say, that roentgen irradiation according to the method of Coutard, offers much better results than other methods. A certain number of patients, even though they were mostly hopeless cases, became entirely symptom-free. In another group the tumors were made operable, no complications occurring during or after the operation. Nearly all of the remainder were influenced palliatively, only a very small fraction remaining refractory to irradiation. We recommend, therefore, the method as the best for the treatment of cancers of the tonsil, of the base of the tongue, of the hypopharynx and of the inner larynx, where laryngeal fissure cannot be performed. It should also be tried in all cases of malignant tumors in which surgical procedure or radium treatment is technically impossible.

REFERENCES

1. COUTARD, H. Sur les délais d'apparition et d'évolution des réactions de la peau, et des muqueuses de la bouche et du pharynx provoquées par les rayons X. *Compt. rend. Soc. de biol.*, 1922, *86*, 1140–1142. Die Röntgenbehandlung der epithelialen Krebse der Tonsillengegend. *Strahlentherapie*, 1929, *33*, 249.
2. JACOBI, H., and LIECHTI, A. Messungen zur Qualität und Intensität der Streustrahlung. *Strahlentherapie*, 1928, *27*, 711–727.
3. PFAHLER, G. E. Saturation method in roentgen-therapy, as applied to deep-seated malignant disease. *Brit. J. Radiol.*, 1926, *31*, 45–58.
4. RÉTHI, A. Die Verhinderung der Aspirationspneumonie mit Hilfe des durch Stimmlippennaht durchgeführten Verschlusses des Kehlkopfeinganges. *Chirurg.*, 1930, *2*, 503–509.
5. SCHINZ, H. R. Gegenwärtige Methoden der Krebsbestrahlung und ihre Erfolge; Verteilte Dosis. *Strahlentherapie*, 1930, *37*, 31–49.
6. WINTZ, H. Die Strahlentherapie des Mammakarzinoms. Handbuch. d. ges. Strahlenheilkunde v. Lazarus. Bd. 2, 3. Lieferung, 1929, p. 575.

Vol. XXV, No. 6

THE CANCER PROBLEM, PRESENT AND FUTURE*

By WILLIAM H. KRAEMER, M.D.
Director of Tumor Clinic, Jefferson Hospital
PHILADELPHIA, PENNSYLVANIA

THE MAGNITUDE OF THE CANCER PROBLEM

THE realization of the seriousness of cancer is the most pressing medical problem confronting the physician at the present time. The insidious nature of this disease makes it very difficult to recognize its presence. Quite often no physical evidence or symptoms are characteristic, and this is the weakest link in the present system of its management.

The attitude of the public, on the other hand, is one of a dubious nature. The average person is not sufficiently impressed with the need of an early discovery if cure is to be effected. The average patient is not sufficiently aware of the present proved methods of cancer treatment, and because of this lack of knowledge, there is a resultant lack of faith in the medical profession, causing patients by the thousands to follow fake cancer cures around the country.

Statistics show that one person out of every nine is afflicted with cancer at some time in his life. Seventy per cent of persons attacked by cancer die from its effects, and of the remaining 30 per cent, practically all are found and treated in the early stages of the cancer development.

In various countries and cities of Europe in 1926, the percentage of death rates from cancer are given as follows:[1]

London	12.6 per cent of all causes of death
Oslo	16.6 per cent of all causes of death
Austria	9.8 per cent of all causes of death
Hungary	4.9 per cent of all causes of death
Lodz (Poland)	7.6 per cent of all causes of death
Spain	3.5 per cent of all causes of death
Jamaica	1.0 per cent of all causes of death

In Jamaica the proportion of cancer deaths is very low, but against this the proportion of deaths from ill-defined and unknown causes is high, 29.7 per cent. I believe this to be true in other countries where the death rate from cancer is unusually low.

The mortality from cancer in the U. S. Registration Area shows that since 1916 the crude cancer death rate increased[2] from 81.1 per 100,000 to 95.6 in 1927. The actual increase, therefore, was 14.5 per 100,000, or approximately 18 per cent.

GOVERNING FACTORS IN THE REALM OF CANCER RESEARCH

In the present light of our knowledge concerning the etiology of cancer, anyone who writes upon this subject must, of necessity, express himself with the utmost reserve.

During the past twenty years more work has been done along the line of cancer research, with the limited funds that have been available, than was done during the preceding hundred years.

Work on the Cause of Cancer.[3]—Progress in the realm of cancer research appears to be dependent upon a gradual accumulation of facts rather than upon revolutionary and outstanding discoveries.

Carcinogenic Agents.—Chemical Irritants Producing Cancer.[3] Experiments with cancer production in mice by means of coal-tar derivatives are being conducted by Kennaway of London, Carminati of Milan, Schabad,[4] Rochlin,[5] Laser,[6] Kreyberg,[7] and others. No light, however, has been thrown upon the mechanism whereby the cancer change is instituted.

Tumor Filtrates.[3]—By far the most prevalent mode of study of the origin of cancer is that conducted upon tumor filtrates with the Rous chicken sarcoma. The search for the potent factor in the filtrate, however, continues. The renewed interest in this subject has come from the experiments of Murphy at the Rockefeller Institute, Heidenhain in Germany, Sternberg in Vienna,

* Read at the Fifteenth Annual Meeting, American Radium Society, Detroit, Mich., June 23-24, 1930.

Borst in Munich, and Leitch and Murray in London.

Tumor Metabolism.[3]—These experiments were conducted over a period of six years by Warburg and his coworkers in the Kaiser Wilhelm Institute of Biology in Berlin. The measurements made by Warburg on cell metabolism are generally agreed to, but their specificity for cancer, as well as their theoretical implications, are the subject of serious contention by other investigators in this field of research, namely, Bierich, Dickens, Crabtree and Borst.

General Systemic Causes in Cancer.[3]—That many workers are turning to the view that cancer is a general systemic disease, has some merit in that up to the present time not a single invariable factor in the origin of cancer has been isolated. Auler in Blumenthal's Clinic, believes that he has found a basis for the assumption that cancer is a general systemic disease in the behavior of the serum of cancer patients in the presence of cancer cells. The nature of these reactions are forthcoming in the *Zeitschrift für Krebsforschung.*

Diagnosis.—The general practitioner (clinician) must become so skilled in the diagnosis of carcinoma that he will be able to recognize its early existence among his patients. He must be able to differentiate its early symptoms from symptoms of other diseases. He is the friend of the masses, their adviser in the earliest stage, and not the specialist. Upon him depends all later treatment, irrespective of its efficiency.

The search for a specific reaction in the blood of cancer patients has not met with any practical success. Carminati working in Fichera's Institute in Milan, Auler in Blumenthal's Clinic, and the late Fry working under Leitch at the Cancer Hospital in London, are among the workers on this problem.

Treatment.—Surgery, the most effective, outstanding and unchallenged of all methods of treatment, however successful in early cases, is absolutely futile and sometimes actually detrimental to the best interests of the patient in advanced stages.

The roentgenologist and the radiologist need no introduction from the standpoint of the clinician because their splendid contributions to the treatment of cancer are universally recognized. They, too, must rely on the physician who was the first to see the patient, and their success depends likewise on his early and correct diagnosis.

A Tumor Clinic, under the auspices of the Department of Health of Massachusetts, was established by Dr. Robert B. Greenough, Dr. Herbert L. Lombard, Dr. Carl R. Doering, and their associates.

A brief summary of some of their cancer clinic policies, it seems to me, would solve many of the problems of cancer:[4]

Clinic doctors should give clear directions to the social worker regarding disposition of the patient and nature of report to be sent to attending physicians.

A list of conditions which may be termed precancerous should be prepared, in order that the same terminology be used in all clinics.

Women over thirty-five who have borne children should obtain a competent opinion as to whether they require surgical repair of lacerated cervices.

At the first visit records should be as complete as possible. A final diagnosis cannot be made, but a medical scheme of procedure should at least be prepared at the first visit and the possible diagnosis recorded.

The local medical cancer committee must instruct the social worker how to handle the patient with no local physician, but able to pay for treatment. It is suggested that the social worker should give such patients a list of names of men qualified to treat the type of disease in question. The local medical committee must supply such a list.

It should be the aim of every cancer clinic to give a complete physical examination. A final diagnosis need not be made for the noncancerous, but at least it would seem that the family physician might be informed that a heart lesion, a lung lesion, or some other condition exists.

The clinic physician should inform the patient or a responsible member of the patient's family of the patient's condition. He may delegate this to a social worker, but she must act as his agent and not on her own responsibility.

It is desirable, in order to avoid misunderstanding, for the social worker to make a personal contact with each private physician on her first case referred to him. In subsequent cases she may notify the physician by personal letter, form letter, telephone or visit, whichever fits the local situation best.

It is important that all patients be followed up by the social worker, and clinics must try to do this as far as possible. Both the cancer case and the non-cancerous case should do this until contact has been made suitable for cure or relief. The well-to-do should be followed up with the same thoroughness as the poor. It must, of course, be remembered that cancer is the first responsibility. But no clinic can feel that it is doing its full duty unless the non-cancerous are followed to adequate resources suitable to their means, since the really staggering problem today is that of degenerative diseases.

The amount of treatment furnished by a given clinic must be determined by the clinic committee. The responsibility of the clinic is to furnish adequate diagnosis, to decide what treatment is required, and to see that the necessary treatment is made available for the individual patient.

The State cancer clinics are intended to supply adequate consultation service on cancer cases for the citizens. In case the family doctor does not agree with the diagnosis of the cancer clinic, arrangements for a further consultation may readily be made. To this end it was agreed that the cancer patient, or a responsible member of his family, should be told of the diagnosis at the clinic before being returned to his private physician.

Colloidal Lead.—It is my privilege to mention this chemical agent which has been used since the time of Galen, and on which much work has recently been done by Bell and his associates at Liverpool, and much credit is due him for the present knowledge of this treatment.

Bell was impressed by the fact that lead causes abortion and arrests the growth of cells in general.[9] Experiments with plants[10] and tadpoles[11] indicate that lead ions, in low concentrations, inhibit plant and animal growth without the actual destruction of cells. Bell[9] maintains that lead is fixed preferentially by growing tissues, probably due to their greater content of phospholipins.

Further evidence to this conclusion is supported by the following articles of Frederick S. Hammett, working at the Research Institute of Lankenau Hospital, and Elizabeth S. Justice:[8]

"The Influence of Lead on Mitosis and Cell Size in the Growing Root."
"The Selective Fixation of Lead by Root Nuclei in Mitosis."
"The Nature of the Lead Compound Deposited in the Growing Root."

The results of this investigation show decisively that in the growing root lead retards cell proliferation, while allowing cell growth in size to proceed unrestricted.

Further, that the mitotic nuclei of the growing root have a special avidity for lead. It is largely because of this that growth of cell proliferation is inhibited by the metallic ion.

Also, analysis of the lead-containing deposit found concentrated in the region of the cell proliferation of roots of seedlings grown in culture solutions containing lead was made by microchemical methods. The various tests indicate that the precipitate is a combination between lead and an organic sulphydryl compound analogous to, if not glutathione itself.

In this connection, it is of interest to note the report of Dr. A. J. Murray of the Bureau of Mines, Utah (Table 1).

Our work in lead therapy was made possible through the generosity of Mr. Pierre S. duPont, sponsor of the Tumor Clinic at Jefferson Hospital, and who made a special arrangement for the preparation of the lead compounds at the duPont Experimental Station in Wilmington.

I do not believe that lead therapy should be used with the idea of breaking down the tumor by producing thrombosis in the vessels, the absorption of which, combined with the lead administered, would in itself hopelessly poison the patient, and there is serious doubt that even though this were

possible, all of the living cancer cells could be destroyed by this process in the tumor, thereby preventing recurrence and metastasis.

My personal belief, as a result of my observation, is that lead has a distinct agent or by combining chemically with the sulphydryl radicle.

Time forbids a detailed discussion of all of the lead compounds that have been used, of which there are now twenty-three. I believe that the one of choice, at the present time, is lead orthophosphate, first prepared by Ullmann and Bischoff and their associates at the Cottage Hospital, Santa Barbara, California.

TABLE I

MALIGNANCY AMONG METAL MINERS, MILL AND SMELTERMEN, AND ALL MALES OVER 16 YEARS OF AGE

Year	Metal Miners	Deaths from Malignant Growths	Rate per 10,000
1918	6,901	5	7.2
1919	4,599	15	32.6
1920	4,965	9	18.1
1921	4,001	6	14.9
1922	4,731	7	14.7
1923	6,146	7	11.3
1924	6,577	7	10.6
			109.4
Year	**Mill and Smeltermen**	**Deaths from Malignant Growths**	**Rate per 10,000**
1918	7,000	2	2.8
1919	3,923	2	5.0
1920	3,979	1	2.5
1921	2,547	0	0.0
1922	3,416	1	2.9
1923	3,796	3	7.9
1924	5,136	0	0.0
			21.1
Year	**All Other Males over 16 Years of Age**	**Deaths from Malignant Growths**	**Rate per 10,000**
1918	123,285*	94	7.6
1919	131,040	114	8.6
1920	133,087	105	7.8
1921	137,529	119	8.6
1922	138,173	135	9.7
1923	138,844	122	8.7
1924	139,734	133	9.5
			60.5

* Estimate based on census of 1910 and 1920.
Note: Not all metal miners are exposed to lead dusts.

In addition to this, I believe that in lead we have another postoperative means of attack upon the metastases of the cancer tissue, by its adverse effect on the nutrition of the tumor cells either as a direct toxic

I believe that the profession has been expecting too much from this treatment. Lead has distinct disadvantages in that it has been effective only in those cases where

acute lead poisoning was produced in the patient. This has been pointed out by Withers of Denver, Bell of Liverpool, Francis Carter Wood of New York, and others.

Those who have had exceptional laboratory facilities for preparing the lead compounds, and have selected their cases carefully, have obtained some favorable results.

SUMMARY

Thus, in closing, I would like to take this opportunity to summarize the outstanding and essential factors as mentioned above. I believe now that the prevalence of cancer warrants the profession to take a view of this problem different from its present one. Cancer has outgrown, so to speak, its classification among the diseases common to mankind. It threatens the very foundation of civilization. How can we meet its rapid advances?

I am of the opinion that every medical teaching institution should have a department in which the subject of cancer is taught as a separate major subject. That a tumor clinic should be founded in every hospital connected with a teaching institution, headed, not by a single man, but by a group of men consisting of surgeons, radiologists, roentgenologists, pathologists and clinicians. That this tumor clinic should secure a complete history, diagnosis, treatment and follow-up report on each case presented at the hospital. That this clinical material should provide the teaching institution with records and clinical cases for demonstration, and material for gross and microscopic pathology.

By this method, the college would be able to instill into its graduates a practical knowledge of the early symptoms of this disease, for the entire success of the treatment depends on the early diagnosis by the clinician.

Further, I believe that lead, as an adjunct to surgery, roentgen rays and radium, has a distinct place in the treatment of cancer, but should never be used alone as a major treatment, nor used with the idea of breaking down a large tumor by producing thrombosis of its vessels.

REFERENCES

1. Statistics taken from *Cancer Review*, 1928, *3*, No. 7.
2. Some Final Results of the San Francisco Cancer Survey, by Frederick L. Hoffman, Consulting Statistician, Prudential Insurance Company of America.
3. *J. Chemical Education*, 1930, *7*, 1000–1025.
4. Schabad, L. M. Tar tumours of the forestomach in mice. *Westnik. Roentgenol. i Radiol.*, 1928, *6*, 223–232. Abs in *Cancer Rev.*, 1929, *4*, 223.
5. Rochlin, D. G. Tar tumours in mice in relation to peculiarities in constitution. *Virchow's Arch. f. path. Anat. (etc.)*, 1928, *269*, 467–479. Abs. in *Cancer Rev.*, 1929, *4*, 328.
6. Laser, H. Experimental carcinogenesis by tar in vitro. *Arch. f. exper. Zellforsch.*, 1928, *6*, 142–146. Abs. in *Cancer Rev.*, 1929, *4*, 327.
7. Kreyberg, L. On local alterations of the blood-vessels of tar-painted white mice. *Brit. J. Exper. Pathol.*, 1928, *8*, 465–469. Abs. in *Cancer Rev.*, 1928, *3*, 317.
8. The enlarging cancer program. *New England J. M.*, 1929, *200*, 105–119.
9. Bell, W. Blair. The influence of saturnine compounds on cell growth, with special reference to the treatment of malignant neoplasms. *Lancet*, 1922, *2*, 1005–1009.
10. Bell, W. Blair, and Patterson, J. *Ann. Applied Biol.*, 1923, *13*, 177.
11. Dilling, W. F., and Others. *Ann. Applied Biol.*, 1926, *13*, 177.
12. Hammett, Frederick S., and Justice, Elizabeth S. Studies in the biology of metals. IV–VI. *Protoplasma*, 1929, *5*, No. 4.

DISCUSSION

Dr. Sanford Withers, Denver, Colo. I believe it is a very good thing for us to hear these well-considered general papers on carcinoma. There should be one or two at every meeting. We are in the midst of this problem and we need to have bird's eye views presented to us every now and then to show us the new paths. Some end in blind alleys; some tend to lead us out of the maze.

I am coming to feel that too much time and

money are spent on cancer research at the expense of cancer treatment. It should be remembered that there is an enormous number of cancer patients who cannot afford to pay for what is considered expensive treatment, and who are too proud to attend a charity clinic. This class is the one most deserving of special attention now. This is particularly true in the Middle West. In that large territory extending from Omaha, St. Louis and New Orleans on the east to the Pacific Coast, there is no adequate cancer clinic or hospital. The East is spending large and larger amounts for cancer treatment. Massachusetts has done splendid things in their cancer program in the last few years. The Steiner Clinic at Atlanta has also greatly expanded its work. Money has been given in immense sums for the treatment of malignant disease. I am therefore amazed to find that more than a million dollars has been donated to two physicians in the far West to carry on their ill-advised, so-called research, with little or no funds available for carrying out *well* recognized practices in the treatment of cancer.

Dr. Kraemer mentioned colloidal lead briefly. As you know, I reported a series of 64 cases of hopeless malignancy at the meeting in Portland. Of these 64 cases treated, 16 patients, or 25 per cent, were alive on June 1, 1929. There is now dead of the disease one patient with carcinoma of the cervix, from thrombosis of iliac vessels. One patient with generalized metastasis died. One died of a stroke (cardiovascular disease). Thirteen patients are living, an average of thirty and one-half months. Of these, one had carcinoma of the ovary with definite metastasis of the liver, proved by laparotomy, and has now developed metastasis in the chest. One patient with xeroderma pigmentosum has had recurrences. Eleven, or 17.2 per cent, are alive, more than thirty months.

DR. H. J. ULLMANN, Santa Barbara, Calif. Dr. Kraemer voiced a phase of the cancer problem which is, as a rule, not taken into consideration by those who are giving money for cancer research, and this was emphasized by Dr. Withers. The American Society for the Control of Cancer has devoted much money and time to the education of the public. In Portland at their booth in the exhibit I talked with their temporary director and he asked me, as he asked every physician who stopped there, what their activity should be from now on. I said, "The education of the physician." He told me that only one physician whom he had asked had given a different answer. It is quite common to have patients come in with a cancer of the uterus who have been bleeding for from six to eighteen months, and who have been under the care of their physician for from three to eighteen months, but who have never had a pelvic examination. They have been given drugs by mouth and told that it was probably menopausal bleeding, and who have of themselves sought the advice of other physicians. It is true that physicians and surgeons as a whole are ignorant of what may be accomplished for cancer. I believe too much money is being given for research. I believe it should be divided into one-third for research, one-third for the education of the profession, and one-third for the care of the unfortunate cancer patient.

Dr. Kraemer also spoke of the necessity for teamwork in cancer. Before the Medical and Surgical Association of the Southwest, at Albuquerque, November, 1928, I read a paper in which I said that this is not a problem of one physician, that it needs the trilogy of the surgeon, the radiologist, and the internist, placed equidistant about the pathologist as a center.

DR. KRAEMER (closing). I would like to show some charts regarding the history and examination of cancer patients, which have been approved by the College of Surgeons. The list, so far, of these charts is incomplete. Those which we now have are for hysterectomy, radium therapy and carcinoma of the rectum.

It appears that I should emphasize at this time one or two points, namely, the education of the physician, which I have already mentioned in my paper. My criticism applies to all of us who have passed through the practice of general medicine into the field of speciality.

The second point I wish to touch upon is that of research work among the heavy metals, which has been going on all over this country and throughout Europe. Statements have been made that lead treatment is used in every hospital in the United States that has a suitable laboratory for the preparation of this lead.

We took it upon ourselves to gather many of the samples used, and after a complete analysis, arrived at the conclusion that the composition of these preparations varied to such an extent that no conclusion as to their therapeutic value could be established.

The final point that I wish to bring out is

that the patients selected for lead treatment were those who were extremely advanced in the disease, and regardless of the treatment applied, little or no improvement could be anticipated.

I will leave it to you whether in making an investigation of the therapeutic effects of such drugs as digitalis, belladonna, quinine, or some operative procedure, or the application of roentgen rays or radium, you would choose, in testing the efficiency of the remedy, patients in extreme moribund state.

In testing the merits of lead therapy, it seems that cases having some chance of recovery or alleviation from the symptoms should be selected, and in this way a more definite and sincere conclusion could be drawn.

AN UNUSUAL CASE OF TRAUMATIC PNEUMOCEPHALUS

By ROBERT B. TAFT, M.D., B.S.
CHARLESTON, SOUTH CAROLINA

THIS case is described because of the extremely large quantity of air within a pocket of the brain substance. As far as I can determine from a comparison of the films with those appearing in the literature, the amount of air in this particular case is as large as any reported. A brief summary of the condition is as follows:

On October 5, 1930, a young white man was brought in for examination of the skull following an automobile accident. He had been knocked unconscious but had regained consciousness while being brought to the hospital. As the film shows (Fig. 1) there were numerous

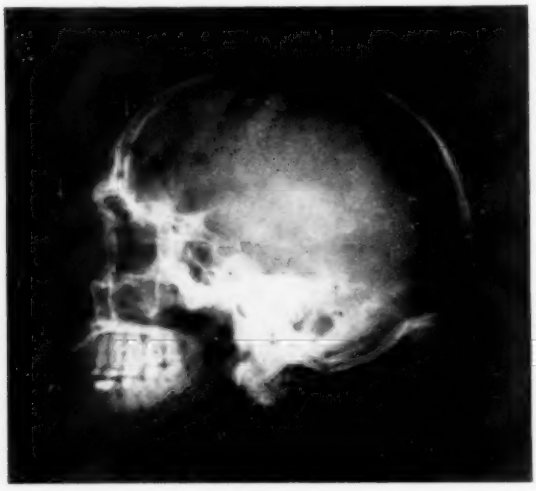


FIG. 1.

crushed fractures of the frontal bone extending into the frontal sinus. He was given conservative treatment; he apparently recovered and was allowed to go home.

He returned on December 30 complaining of headache and profuse watery discharge from the nose. He was then referred to me for roentgen examination of the sinuses and it was on the edge of the sinus film that the air bubble was seen. Films of the entire skull showed an enormous collection of air in the right frontal region (Figs. 2 and 3). No shift in the position of the bubble could be determined when the films were made in several positions of the head. No air was seen in the ventricles and none in the subarachnoid space.

At this time he was suffering intensely from headache but was clear mentally. Pupils were

FIG. 2.

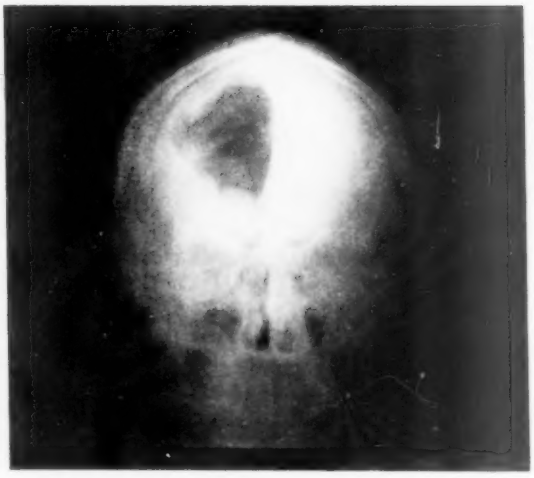


FIG. 3.

sometimes slightly constricted and sometimes slightly dilated. Vision was good. Large quantities of watery material continued to flow from the nose. Death took place on January 20, 1931, following a convulsion.

At autopsy all the ventricles were partly filled with greenish pus. There was a hole through the right cribriform plate about $\frac{5}{8}$ inch in length, anteroposteriorly and about $\frac{3}{8}$ inch wide. The brain seemed to be adherent around this, and over the hole was a passageway entering the frontal lobe of the brain. After removal of the brain, the air bubble had collapsed so that it was impossible to determine its true size. It seemed that the brain substance had simply been forced aside to accommodate the air.

No attempt is made here to go into a discussion of the condition or of the literature as the matter has been well covered by recent papers.[1,2]

REFERENCES

1. Miller, S. W., Klemmer, R. N., and Snoke, P. O. Traumatic pneumocephalus. *J. Am. M. Ass.*, Jan. 17, 1931, *96*, 172–173.

2. Rand, C. W. Traumatic pneumocephalus; report of 8 cases. *Arch. Surg.*, 1930, *20*, 935–958.

UNUSUAL MIGRATION OF A FOREIGN BODY

By WILLIAM A. EVANS, M.D.
DETROIT, MICHIGAN

ROENTGENOLOGISTS of experience are familiar with the movements of foreign substances in the body tissues and it is this knowledge that prompts them to urge re-examination immediately preceding any attempt at removal. They have learned that muscular contractions and tendon movements within the sheaths may cause shifting in position; that coughing and respiratory movements or vomiting will cause movement from esophagus to lung, or lung to lung, or lung to stomach and lower in the alimentary tract; that unusual changes in position occur through the various blood channels, particles traveling from extremity to heart and lungs or in the reverse direction. With these and other observations, they appreciate the necessity for check-up studies immediately preliminary to operation for foreign body removal.

My experience in a recent case suggests the value of making such studies routinely.

Mr. J. S., a press operator in a machine shop, was referred by Dr. William A. Spitzley for study of the abdominal wall. A puncture wound had been received and a foreign body was suspected.

Roentgen films limited to the immediate area of injury demonstrated a metallic sliver some 5 cm. in length (Fig. 1) lying transversely in the abdominal wall at right angles to the spine.

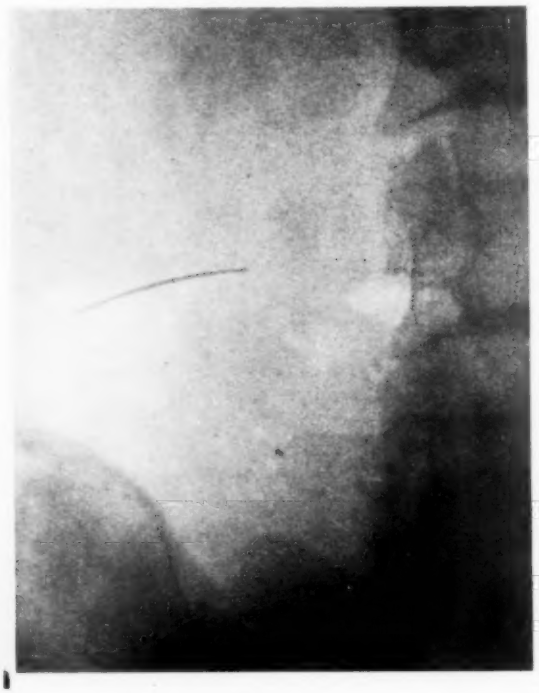


FIG. 1.

FIG. 2.

Removal of this was attempted within twenty-four hours, no further examination being made. Thorough search of the field was unsuccessful and the patient was returned for additional roentgen studies. Again the study was limited to the region of the point of entry, with negative findings. Then the entire abdomen was included in the study and the foreign body was seen to be in the lower left pelvic cavity (Fig. 2).

The question arose as to whether the piece of metal was free in the abdominal cavity or had entered the intestinal canal, and the patient was hospitalized for closer observation.

Nothing of interest developed until the end of the fourth day when the piece of metal was recovered from the stool (Fig. 3).

This case report is made to emphasize the necessity of localization of foreign bodies immediately before attempted removal.

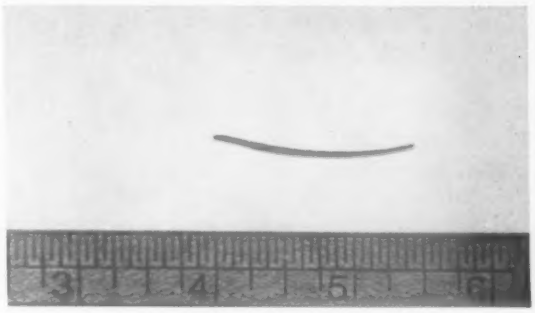


Fig. 3.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: LAWRENCE REYNOLDS, M.D.

Editorial Board: A. C. CHRISTIE, M.D. E. H. SKINNER, M.D. WILLIAM DUANE, PH.D.
Advisory Board for Pathology: JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

Collaborating Editors: The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.
Foreign Collaborators: A. BÉCLÈRE, M.D., PARIS, GÖSTA FORSSELL, M.D., STOCKHOLM, G. F. HAENISCH, M.D., HAMBURG, R. LEDOUX-LEBARD, M.D., PARIS.

Publisher: CHARLES C. THOMAS, SPRINGFIELD, ILL.

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield. Ill. Information of interest to all readers will be found on page iv.

Officers and Standing Committees

THE AMERICAN ROENTGEN RAY SOCIETY

President: A. B. MOORE, Washington, D. C.; *President-Elect:* LEOPOLD JACHES, New York City; *1st Vice-President:* E. L. JENKINSON, Chicago, Ill.; *2d Vice-President:* E. P. PENDERGRASS, Philadelphia, Pa.; *Secretary:* JOHN T. MURPHY, 421 Michigan St., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Historian:* E. H. SKINNER, Kansas City, Mo.

Executive Council: L. R. Sante, Chairman, 606 Missouri Bldg., St. Louis, Mo., F. M. HODGES, Richmond, Va., CHARLES A. WATERS, Baltimore, Md., A. B. MOORE, Washington, D. C., LEOPOLD JACHES, New York City, LAWRENCE REYNOLDS, Detroit, Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

Committee on Laws and Public Policy: B. R. KIRKLIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

Committee on Safety and Standards: H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio, G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

Publication Committee: WILLIAM A. EVANS, Chairman, Detroit, Mich., L. R. SANTE, St. Louis, Mo., F. M. HODGES, Richmond, Va.

Leonard Prize Committee: A. C. CHRISTIE, Washington, D. C., W. A. EVANS, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E. PFAHLER, Philadelphia, Pa.

Tube Committee: DAVID R. BOWEN, Chairman, Philadelphia, Pa., I. H. LOCKWOOD, Kansas City, Mo., E. C. ERNST, St. Louis, Mo., G. W. GRIER, Pittsburgh, Pa., E. A. POHLE, Madison, Wis.

Member, National Research Council: W. F. MANGES, Philadelphia, Pa.

Delegate to Third International Congress of Radiology, Paris, July 27–31, 1931: G. E. PFAHLER, Philadelphia, Pa.; Alternate, THOMAS A. GROOVER, Washington, D. C.

Editor: LAWRENCE REYNOLDS, 110 Professional Building, Detroit, Mich.

Editorial Board: A. C. CHRISTIE, E. H. SKINNER, WM. DUANE.

Advisory Board for Pathology: JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

Publisher: CHARLES C. THOMAS, 220 East Monroe St., Springfield, Ill.

Thirty-second Annual Meeting: Haddon Hall, Atlantic City, N. J., September 22–25, 1931.

THE AMERICAN RADIUM SOCIETY

President: H. J. ULLMANN, 1520 Chapala St., Santa Barbara, Calif.; *President-Elect:* SANFORD WITHERS, Denver, Colo.; *First Vice-President:* BURTON J. LEE, New York City; *Second Vice-President:* Edward H. SKINNER, Kansas City, Mo.; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins Arcade, Pittsburgh, Pa.

Executive Committee: CURTIS F. BURNAM, Chairman, 1418 Eutaw Place, Baltimore, Md., EDWIN C. ERNST, St. Louis, Mo., H. H. BOWING, Rochester, Minn.

Program Committee: SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., BURTON J. LEE, New York City, HENRY SCHMITZ, Chicago.

Publication Committee: EDWARD H. SKINNER, Chairman, 1532 Professional Bldg., Kansas City, Mo., HENRY SCHMITZ, Chicago, DOUGLAS QUICK, New York City.

Research and Standardization Committee: G. FAILLA, Chairman, Memorial Hospital, New York City, H. J. ULLMANN, Santa Barbara, Calif., R. B. GREENOUGH, Boston, Mass.

Education and Publicity Committee: SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., G. E. PFAHLER, Philadelphia, T. D. QUIGLEY, Omaha, Nebr.

Sixteenth Annual Meeting: Philadelphia, Pa., June 8–9, 1931.

Committee on Arrangements: G. E. PFAHLER, Chairman, 1321 Spruce St., Philadelphia, W. S. NEWCOMET, Philadelphia, W. H. SCHMIDT, Philadelphia, W. L. CLARK, Philadelphia, W. H. KRAEMER, Philadelphia, B. P. WIDMANN, Philadelphia.

EDITORIAL

THE INTERVERTEBRAL DISC

CLINICAL roentgenography owes a tremendous debt of gratitude to Potter for his elaboration of the Bucky diaphragm and making its use practical. The proof of this statement is no better illustrated than by the recent revival of interest in the study of the vertebral column stimulated by the work of Schmorl. The diseases which manifest themselves primarily in the bony structure of the spine have since the early days of roentgenography been a source of interest and more or less detailed study, but not until Schmorl's illuminating studies on the vertebral column which he made at routine post-mortem examinations was the importance of the intervertebral disc appreciated, not only the part it plays in the normal movements of the spine but also in its pathologic states. While these studies were made at post-mortem examination, the pathologic states can as readily be demonstrated in routine roentgenograms of the living with the fine detail made possible by the use of the Potter-Bucky diaphragm.

Schmorl[1] in his studies called particular attention to the intervertebral disc extensions into the adjacent vertebral bodies or into the spinal canal. Since his first description of the pathological picture of the intervertebral disc extensions into the vertebral bodies, a number of papers have appeared in the foreign literature, and recently several papers have been published in English calling attention to the importance of Schmorl's observations and also to their clinical application. Calvé and Galland[2] recently published a very comprehensive article on the intervertebral nucleus pulposus and more recently Sashin[3] and Geist[4] have written on the same subject.

Since the intervertebral disc comprises such a large part of the vertebral length, namely, from one-fourth to one-fifth, it is as Geist says, somewhat unusual that more attention has not been paid to it in pathologic states of the spine.

Anatomically the discs are intimately attached to the compact bony rim of the vertebral body and loosely attached to its sieve-like surface. In the adult stage these intervertebral discs contain neither blood vessels nor nerves. The discs become thinner as age advances and, as Geist suggests, this is one of the chief causes of the loss of bodily height in elderly people.

Anatomically the disc is composed of three distinct parts: the nucleus pulposus, the annulus fibrosus and the cartilage plate or "knorpel-platte" of Schmorl. The intervertebral discs vary in shape and size with the bodies to which they are attached. "They are widest and thickest in the lumbar region. In the cervical and lumbar regions they are thicker in front than behind, giving rise to a forward convexity of the spine. In the thoracic region, the disks are flattened and have only a slight effect on the posterior convexity of the dorsal part of the spine." The elasticity of the intervertebral disc rests exclusively in the nucleus pulposus which is normally situated slightly behind the median line of the disc.

[1] Schmorl, G. Verkalkung der Bandscheiben der Wirbelsäule nebst bemerkungen ueber das Verhalten der Bandscheiben bei infektiöser Spondylitis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1929, *40*, 18–26. Abs. Am. J. Roentgenol. & Rad. Therapy, 1930, *23*, 107. Ueber Knörpelknoten an der Hinterflache der Wirbelbandscheiben. *Ibid.*, 629–634. Abs. Am. J. Roentgenol. & Rad. Therapy, 1930, *24*, 97.

[2] Calvé, Jacques, and Galland, Marcel. Le nucleus pulposus intervertébral; son anatomie, sa physiologie, sa pathologie. *Presse méd.*, 1930, *38*, 520–524. Abs. Am. J. Roentgenol & Rad. Therapy, 1930, *24*, 594. See also *J. Bone & Joint Surg.*, 1930, *12*, 555–578.

[3] Sashin, David. Intervertebral disk extensions into the vertebral bodies and spinal canal. *Arch. Surg.*, April, 1931, *22*, 527–547.

[4] Geist, Emil S. The intervertebral disk. *J. Am. M. Ass.*, May 16, 1931, *96*, 1676–1679.

It is chiefly composed of the remains of the notochord, a semifluid ground substance, débris, and cartilage cells. It is comparatively large in children and recedes in size as age advances. Normally it never disappears.

The annulus fibrosus forms the major part of the intervertebral disc. It is composed of fibrocartilage arranged in a definitely planned and somewhat complicated scheme of lamellation. It is firmly attached to the cancellous rim of the vertebral body by an arrangement similar to Sharpey's fibers.

The cartilage plate is in contact with the surface of the vertebral body. It is thicker and more resistant in the child. It is rather loosely attached to the underlying sievelike surface of the vertebral body and can be readily detached.

The flexibility and movements of the spine are dependent on and involve the intervertebral disc, the disc being compressed and stretched during motion. "The disc is more or less under permanent pressure, both internal and external. The internal pressure is due to the nucleus pulposus while the external pressure is due to the superincumbent weight of the overlying parts. The nucleus pulposus activates the spine. It may be compared to a compressed spring or to a water pillow. The nucleus pulposus is a fulcrum about which the intervertebral motion occurs. While the annulus fibrosus is the weight-bearing portion of the disc and the cartilage plate serves as a limiting membrane of the disc above and below." It will be seen, as Geist suggests, that the intervertebral disc acts as an admirable bolster which receives and absorbs shocks and jars; it is also an organ of movement of the spine and is not as has been so often thought, a passive organ. Injury and diseases of the spine affect the disc as well as other structures concerned. As a result of the studies of Schmorl and others the pathology of the disc can be classified as follows: "(1) the pathologic conditions of the disc itself, (2) those pathologic conditions in which the disk plays the preeminent part, and (3) those conditions in which pathologic conditions of the disk are of secondary nature (although, nevertheless, it may be of considerable clinical and roentgenologic importance)."

The pathologic conditions of the disc itself comprise the congenital anomalies which occur quite rarely. They consist of fetal remains of the notochord attached to the disc and extend into the body of the adjacent vertebra. These are rarely the cause of clinical symptoms but may and ought to be recognized on the roentgenogram when they do occur. Calcification of the disc occurs but is thought to be a fairly infrequent occurrence, though its occurrence is probably much more frequent than its recognition, as a careful survey of roentgenograms will often reveal a calcified disc. Their exact clinical importance is not generally understood (Geist). The chief pathologic states of the spine in which the disc plays the preeminent part are prolapse of the disc. Schmorl found it present in 38 per cent in a series of 3,000 autopsies. These prolapses may be multiple or isolated. The lumbar and cervical are the portions of the spine most frequently affected. The prolapse of the disc may be a combination of active forces within the disc (internal pressure of the nucleus pulposus) together with a weakening from disease or injury of the cartilage plate or of the underlying spongy bone of the vertebral body. The causes of weakening of the cartilage plate are usually due to injury such as small tears or fractures occurring in the cartilage plate." Schmorl called attention to the fact that the cartilage plate in young persons may be overstretched, causing weakening and secondary prolapse. The other cause for cartilage prolapse is weakness of the underlying bone due to atrophy, injury or destructive disease. These prolapses may vary in shape and size and may be quite irregular; they may also be very small or large, at times being so large as to displace and occupy practically the entire vertebral body. Where the prolapse has existed for some time there

may occur a defense reaction on the part of the spongiosa and this reaction may manifest itself by laying down of new bone which surrounds the prolapsed cartilage of the disc and walls it off. This new bone formation may be recognized in the roentgenogram. While the prolapse of the nucleus pulposus usually occurs into the adjacent vertebra, it may extend into the vertebral canal. In cases of this type the prolapse is usually small and may be of no clinical significance, though cases have been reported in which its extension into the vertebral canal has given rise to neurological symptoms which necessitated operation, as instanced by the report of two cases by Dandy.[5]

Clinically it has been observed that cartilaginous prolapses are more frequent in men, especially in the active ages of life.

Geist calls attention to the fact that there exists considerable difference of opinion as to the clinical meaning of these cartilaginous prolapses. Schmorl, who first called attention to them, does not ascribe to them any particular clinical significance. On the other hand Schanz, a prominent orthopedic surgeon of Dresden, is inclined to give considerable weight to them, attributing to them the basis of an explanation of some of the so-called "painful backs." In fractures, especially of the cervical spine the disc is often injured and in fractures of the lumbar spine the disc is usually injured. If the disc is badly injured there may result a lessened resilience of the nucleus pulposus and in such cases the secondary changes of spondylitis occur.

A knowledge of the anatomy and physiology of the disc may play a part in explaining the cause of the deformity in scoliosis.

Herniation of the nucleus pulposus into the vertebral body has been in many instances wrongly diagnosed as epiphysitis. Schmorl in his analysis of a total of 4,000 vertebral columns has never observed a single case of a lesion of the epiphysis and Calvé and Galland suggest that the name epiphysitis should be limited to painful manifestations during the period of adolescence, sometimes with kyphoses, and in which no deformity of the disc has been observed, but only epiphyseal points prematurely or too largely developed showing as dark elevated areas, with prominent outlines in the lateral roentgenograms.

Schmorl expressed the belief that the cartilage nodes in young adults lead to the early development of spondylitis deformans. A pre-existing pathologic condition or structural weakness of the vertebral bodies appears to be the underlying cause of a number of disc extensions, and the precipitating factor in these cases is usually trauma. Some observers, notably Müller, contend that only multiple disc nodes of the vertebral bodies give rise to symptoms; others contend from their observations that intervertebral disc extensions of traumatic origin, whether single or multiple, give rise to signs and symptoms (Sashin). The demonstration of intervertebral disc nodes in roentgenograms is of importance especially in medicolegal cases and their recognition and correct interpretation are, as Sashin says, imperative. It is also of equal importance that the examiner recognize the fact that there may be present irregularities of the vertebral bodies which may simulate intervertebral disc node extension, as it is observed often in individuals who come for examinations of the spine for conditions other than those associated with trauma that irregularities are present and unless a careful interpretation is made of suspected cases some harm may come from an overenthusiastic attempt to diagnose intervertebral disc node extensions.

Roentgenographically these disc extensions are seen as small areas of decreased density or small defects in the cortical plate and spongiosa and since these conditions arise so frequently in association with trauma it places an added burden on the roentgenologist in the proper interpretation of roentgenograms of the spine.

[5] Dandy, Walter E. Loose cartilage from intervertebral disk simulating tumor of the spinal cord. *Arch. Surg.*, 1929, *19*, 660–672. Abs. Am. J. Roentgenol. & Rad. Therapy, 1930, *23*, 106.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-second annual meeting: Haddon Hall, Atlantic City, N. J., Sept. 22-25, 1931.

American College of Radiology
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual Meeting: Philadelphia, 1931.

Section on Radiology, American Medical Association
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting: Philadelphia, June 8–12, 1931.

Radiological Society of North America
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.
Seventeenth annual session: Hotel Jefferson, St. Louis, Mo., Nov. 30–Dec. 4, 1931.

Radiological Section, Los Angeles County Medical Society
Secretary, Dr. John F. Chapman, 209 Professional Bldg., Pasadena, Calif.
Meets on the third Wednesday of each month at the California Hospital.

Radiological Section, Southern Medical Association
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Masterson, 401-76th St., Brooklyn, N.Y.
Meets monthly on the first Tuesday from October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

Chicago Roentgen Society
Secretary, Dr. George M. Landau, 660 Groveland Park.
Meeting second Thursday of each month October to May inclusive at Virginia Hotel.

Cleveland Radiological Society
Secretary, Dr. A. Srauss, 518 Medical Arts Bldg.
Meetings are held at 6:15 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

Illinois Radiological Society
Secretary, Dr. Fauntleroy Flinn, 220 South Webster St., Decatur, Ill.
Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

Milwaukee Roentgen Ray Society
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

Minnesota Radiological Society
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.
Next meeting: Rochester, Minn., October, 1931

New England Roentgen Ray Society
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

New York Roentgen Society
Secretary, Dr. J. Bennett Edwards, Englewood Hospital Englewood, N. J.
Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

Central New York Roentgen Ray Society
Secretary, Dr. Robert C. Hall, 258 Genesee St., Utica, N.Y.
Three meetings a year—January, May and November.

Pennsylvania Radiological Society
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Next meeting, to be announced.

Philadelphia Roentgen Ray Society
Secretary, Dr. Karl Kornblum, 3400 Spruce St.
Meeting first Thursday of each month from October to May inclusive, at 8:15 p.m., in Thomson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Camp C. Thomas, 476 Lake Ave.
Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

St. Louis Roentgen Club
Secretary-Treasurer, Dr. E. W. Spinzig, 316 Metropolitan Bldg.
Meets first week of each month. Time and place of meetings designated by president.

Texas Radiological Society
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

University of Michigan Roentgen Ray Society
Secretary, Dr. B. D. Harrington, University Hospital, Ann Arbor, Mich.
Meets every Wednesday evening from October to June, at 7:30 o'clock in the amphitheatre of the University Hospital.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

Virginia Roentgen Ray Club
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Next meeting, to be announced.

Cuba

Sociedad Cubana de Radiologia y Fisioterapia
Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

Section on Radiology, Canadian Medical Association
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

Continental Europe

Belgian Society of Roentgenology
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

Societe de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Francaise d'Electrothérapie et de Radiologie Médicale.
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Süd- und Westdeutsche Röntgengesellschaft
Meets annually in different cities.

Nord- und Ostdeutsche Roentgengesellschaft
Meets annualy in different cities.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
Secretary, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime:

Society of Medical Radiology of Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
Secretary, Dr. G. Biering, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Society of Roentgenology
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets first Tuesday each month, October to July.

Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.
Next meeting to be held April 1, 1931.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto, Japan. Meets bi-monthly on third Sunday.

AMERICAN ROENTGEN RAY SOCIETY

ANNUAL MEETING

The Thirty-second Annual Meeting of the American Roentgen Ray Society will be held at Atlantic City, N. J., from September 22 to 25, 1931. Haddon Hall has been chosen as the headquarters and there all meetings and exhibits will be held. It is suggested that reservations be made as early as possible.

The following is the preliminary program:

PRELIMINARY PROGRAM

The Evaluation of Ventriculography and Pneumoencephalography. A. W. Adson, M.D., Mayo Clinic, Rochester, Minn. (By invitation.)

Encephalography in Children. R. Cannon Eley, M.D., and E. C. Vogt, M.D., Boston, Mass. (By invitation.)

Calcification in Gliomas. M. C. Sosman, M.D., and Louise Eisenhardt, M.D., Boston, Mass.

Explanation of Errors in the Diagnosis of Pituitary Lesions. H. K. Pancoast, M.D., Philadelphia, Pennsylvania.

Sinus Roentgenology. Dorwin L. Palmer, M.D., Portland, Oregon.

Optic Foramina. Paul C. Hodges, M.D., Chicago, Illinois.

Some Observations in the Use of Intravenous Urography. Karl Kornblum, M.D., Philadelphia Pennsylvania. (By invitation.)

Unusual Types of Pneumonia Resulting from Aspirations of Fats and Oils. J. W. Pierson, M.D., Baltimore, Maryland.

Miliary Lung Lesions. R. R. Sayers, M.A., M.D., and F. V. Meriwether, M.D., Washington, D.C. (By invitation.)

Roentgen Examination as an Aid to the Diagnosis of Bulbar Paralysis. Arthur C. Christie, M.D., Washington, D. C.

Pyloric Stenosis with Hypertrophy of the Pyloric Muscle in the Adult. E. P. McNamee, M.D., Cleveland, Ohio.

The Advantages of Fluoroscopic Control in Radiography of the Stomach. G. W. Grier, M.D., Pittsburgh, Pennsylvania.

An Evaluation of Compression Technique in Roentgen Diagnosis of Duodenal Lesions. Milton J. Geyman, M.D., Santa Barbara, California. (By invitation.)

Urography in Urinary Tract Anomalies in Children. Meredith Campbell, M.D., New York City. (By invitation.)

Roentgenological Aspect of Pyelitis of Pregnancy. S. A. Robins, M.D., Boston, Massachusetts.

An Ascending Foreign Body in the Kidney Pelvis. T. P. Waring, M.D. (by invitation), and Robert Drane, M.D., Savannah, Georgia.

Roentgen Study of the Vertebral Body. William A. Evans, M.D., Detroit, Michigan.

Tuberculosis of the Spine. A Report of Several Unusual Cases. Eugene P. Pendergrass, M.D., and Louis Nathanson, M.D., Philadelphia, Pennsylvania.

Tuberculosis of the Shaft. Ralph Bromer, M.D., and E. E. Downs, M.D., Philadelphia, Pennsylvania.

Benign Giant Cell Tumors. B. R. Kirklin, M.D., Rochester, Minnesota, and A. B. Moore, M.D., Washington, D. C.

A Study of the Hip Joint from the Standpoint of the Roentgenologist. L. B. Morrison, M.D., Boston, Massachusetts.

Roentgenological and Legal Aspects of Fractures of the Jaw. S. W. Donaldson, M.D., Ann Arbor, Michigan.

Fractures and Epiphyseal Separation. Fractures of the Ankle: A Classification of 325 Cases According to the Mechanism of their Reduction. Paul A. Bishop, M.D., Philadelphia, Pennsylvania.

Caldwell Lecture: Subject to be announced later. Professor Dr. Fedor Haenisch, Hamburg, Germany.

Unfamiliar Pathology of the Mucosa and Submucosa of the Stomach. A. Chronic Edema of the Mucosa and Submucosa of the Stomach. William Gregory Cole, M.D., New York City. B. Diffuse Hyperplasia of the Connective Tissue of the Submucosa of the Stomach. Robert Earl Pound, M.D., New York City. C. Anatomy of the Lymphoid Follicles of the Mucosa and Submucosa of the Stomach. Russell Wright Morse, M.D., New York City. D. Pathology of the Lymphoid Tissue of the Stomach, Lewis Gregory Cole, M.D., New York City.

Change in Quality of Roentgen Rays at Different Tissue Depths. Edith H. Quimby, M.A., and Robert P. F. McNattin, M.D., New York City. (By invitation.)

Recovery from Roentgen-ray Effects as Observed in the Arbacia Egg. G. S. Henshaw, Ph.D., and G. Failla, D. Sc., New York City. (By invitation.)

Report on the International Comparison of X-ray Standards. L. S. Taylor, Bureau of Standards, Washington, D. C. (By invitation.)

The Principle of Absorption and the Method of Multiple Converging Beams. A. U. Desjardins, M.D., Mayo Clinic, Rochester, Minnesota.

Water Phantom Intensity Measurements of Roentgen Rays Produced by 130,000 volts. J. L. Weatherwax, M.A., and Charles Robb, E.E., Philadelphia, Pennsylvania. (By invitation.)

Concerning the Visibility of the Roentgen Ray. Robert B. Taft, B.S., M.D., Charleston, South Carolina.

Small Platinum Needles as a Substitute for Radon

Implants. Charles L. Martin, M.D., Dallas, Texas.

Further Experience with Gurwitsch's Mitogenetic Radiation. Otto Glasser, Ph.D., Cleveland, Ohio.

Roentgen Therapy of the Epitheliomas of the Tonsil, Larynx and Hypopharynx—1920–1926. Dr. H. Coutard, Paris, France. (By invitation.)

Development of Technique and Results in the Treatment of Tumors in the Nasal and Oral Cavities. Elis Berven, M.D., Stockholm, Sweden. (By invitation.)

Principles and Methods Employed in the Treatment of Intra-Oral Epidermoid Carcinoma. Douglas Quick, M.B. (Tor.). New York City.

Primary Carcinoma of the Lung—Roentgen Diagnosis and Preliminary Report on Roentgen Therapy. Willis F. Manges, M.D., Philadelphia, Pennsylvania.

The Clinical Application of the Roentgen Ray in Angina Pectoris. E. C. Samuel, M.D. and E. R. Bowie, B.S., M.D., New Orleans, Louisiana.

Myelogenous Leukemia. E. L. Jenkinson, M.D., Chicago, Illinois.

Treatment of Hodgkin's Disease. Ross Golden, M.D. New York City.

Carcinoma of the Cervix: An Evaluation of the Results of Treatment with (1). Radium Alone, (2) Radium Plus Deep X-ray Therapy. C. A. Behney, M.D., Philadelphia, Pa. (By invitation.)

Unfiltered Roentgen Rays for External Cancers of Wide and Deep Involvement. B. P. Widmann, M.D., Philadelphia, Pennsylvania.

X-ray Therapy for Some Tumors of the Genitourinary Tract. U. V. Portmann, M.D., Cleveland, Ohio.

Treatment of Testicular Malignancies. John T. Murphy, M.D., and Thomas H. Ramsey, M.D., Toledo, Ohio.

Giant Cell Bone Tumor—A Consideration of the Value of Various Methods of Treatment Both Surgical and Radiological. Carleton B. Peirce, M.D., Ann Arbor, Michigan.

The Treatment of Giant Cell Tumors by Roentgen Therapy. G. E. Pfahler, Sc. D., M.D., and L.D. Parry, M.D., Philadelphia, Pennsylvania.

A Type of Cell Division from Its Medical Biology. S. P. Reimann, M.D., Philadelphia, Pa. (By invitation.)

The Chemistry of Cell Division. F. S. Hammett, M.D., Philadelphia, Pennsylvania. (By invitation.)

Studies of the Diseases of the Lymph Glands from the Hematological and Radiotherapeutic Viewpoint. Nathan Rosenthal, M.D., William Harris, M.D. and Albert Kean, M.D., New York City. (By invitation.)

Aiding Research in Radiology. Rollin H. Stevens. M.D., Detroit, Michigan.

Experimental Studies of the Blood Following Small Doses of X-ray. Charles A. Waters, M.D., and Whitmer B. Firor, M.D., Baltimore, Maryland.

Further Investigations in Hepatography and Lienography Following the Administration of Thorotrast. William H. Stewart, M.D., Max Einhorn, M.D., and H. Earl Illick, M.D., New York City.

Life History of a Lithopedion Told by X-ray. L. R. Sante, M.D., and Fred Emmert, M.D., St. Louis, Missouri.

ILLINOIS RADIOLOGICAL SOCIETY

At the April, 1931, meeting of the Central Illinois Radiological Society held at Peoria, Illinois, the Society voted to change its name to that of the Illinois Radiological Society in order to indicate more correctly the scope of its membership. This Society was largely organized by a small group of radiologists from central Illinois in 1920, but has steadily grown and now has members from every section of the State.

The Illinois Radiological Society is one of the oldest state radiological societies in the West. At its recent Peoria meeting the Society, by unanimous vote of all present, voted to make "*The Radiological Review*" its official publication.

The officers of the Society for 1931 are: President: Dr. C. E. Morgan, Mattoon; Secretary: Dr. Fauntleroy Flinn, 220 South Webster St., Decatur.

MINNESOTA RADIOLOGICAL SOCIETY

The annual meeting of the Minnesota Radiological Society was held in Minneapolis May 4, 1931. The following program was presented:

Round Table Discussions

"Therapeutic X-ray Dosage and Measurement Problems." Conducted by Dr. E. T. Leddy, Rochester.

"Gastric Ulcer." Conducted by Dr. J. Richards Aurelius, St. Paul.

"Traumatic Spine Lesions." Conducted by Dr. Gage Clement, Duluth.

"The Chest in Children." Conducted by Dr. Malcolm B. Hanson, Minneapolis.

There was an informal dinner after which the following addresses were given:

"The Intervertebral Disc." By Dr. Emil S. Geist, Minneapolis.

"Pathologic and Roentgenologic Study of Joint Diseases." By Dr. R. K. Ghormley, Rochester.

The present officers were re-elected for the coming year, as follows: President: Dr. B. R. Kirklin, Rochester; Vice-president: Dr. Gage Clement, Duluth; Secretary-Treasurer: Dr. Leo G. Rigler, Minneapolis.

The next meeting of the society will be held in October, 1931, at Rochester, Minn.

UNIVERSITY OF MICHIGAN ROENTGEN SOCIETY

On April 2, 1931, the members of the Detroit Roentgen Ray and Radium Society and the members of the staff of the Maybury Sanatorium at Northville, Michigan, were guests of the University of Michigan Roentgen Society. The scientific program was begun at 8:00 P.M. Dr. John Alexander, associate professor of surgery, University of Michigan, presented a paper with illustrative films on "The Transthoracic Removal of Foreign Bodies from the Lung and Mediastinum". Dr. Hudson of Detroit and Dr. Gale of the Department of Surgery, University of Wisconsin, led the discussion.

Dr. Cecil S. Wright presented several cases of unusual clinical and roentgenologic interest seen recently in the department.

On April 16, 1931, Otto Glasser, Ph.D., biophysicist of the Cleveland Clinic, Cleveland, Ohio, presented a paper on "The Evolution of Roentgen Rays." Slides illustrating early development of apparatus, early literature, personal communications relative to Roentgen's discovery, and photographs were shown.

POST GRADUATE LECTURES ON CANCER

A course of lectures on biological problems and therapeutics concerning cancer will be held at the Institute for Cancer Research of the Faculty of Medicine of Paris from July 20 to 26, 1931, under the supervision of Professor G. Roussy, with the collaboration of the staff of the Institute.

The lectures will be delivered every day from 10 to 12 A.M. at the Institute and will take up the following subjects:

1. Survey of the biological problem of cancer.
2. Treatment of cancer by radio-surgical combination; with special reference to the breast, uterus, skin and thyroid.
3. New facts about experimental cancer.
4. Culture of tissues in cancer study.
5. Chemistry and chemical treatment of cancer.
6. Prognosis from a histological study of cancer.
7. Social service for cancer and anticancerous armament in France.

The fee for the course is 500 francs (20 dollars). A certificate, signed by the professor, will be given after the course to every doctor who has attended it regularly.

For further information and registration, apply to the "Association pour le Developpement des Relations Medicales," Salle Beclard, Faculte de Medicine, Paris.

LESSONS ON CLINICAL RADIOLOGY

A "Week of Clinical Radiology" will be given by R. Ledoux-Lebard, associate professor, and Belot and Maingot, radiologists of the hospitals of Paris from July 20 to July 25, 1931, in the afternoon from three to six. There will be a demonstration of the principal and newest techniques, and visits to the most modern departments. The first meeting will be held on Monday, July 20, at 3 P.M. in the Service of Clinical Radiology of the Medical Faculty of Paris, at the Hospice de la Salpetriere, 47, Boulevard de l'Hopital.

The following is the program of lessons:

1. Roentgen exploration of the mucosa.
2. Peptic ulcers.
3. Roentgen diagnosis of the urinary tract.
4. Roentgen diagnosis of genital conditions.

5. Superficial roentgen therapy.
6. The accomplishments of deep roentgen therapy.

The fee for the course is 500 francs (20 dollars). A certificate, signed by the professor, will be given after the course to every doctor who has attended it regularly.

For further information and registration, apply to the "Association pour le Developpement des Relations Medicales," Salle Beclard, Faculte de Medicine, Paris.

DR. BLAINE GOES TO CALIFORNIA

Dr. Edward S. Blaine formerly chief of the x-ray departments of Cook County Hospital and Wesley Memorial Hospital, Chicago, has gone to Los Angeles to take over the offices and x-ray laboratory of the late Dr. William B. Bowman in the Roosevelt Building.

DEPARTMENT OF TECHNIQUE

Department Editor: ROBERT B. TAFT, 105 Rutledge Ave., Charleston, S. C.

THE GRID DIAPHRAGM PRINCIPLE APPLIED TO ROENTGENOGRAPHY OF THE PARANASAL SINUSES*

By HOLLIS E. POTTER, M.D.

CHICAGO, ILLINOIS

IN attempting to apply the grid diaphragm principle to the routine study of the sinuses, three general points were determined in advance. First, the patient should be in a sitting posture with head bowed just slightly forward. Second, the apparatus should provide for the accurate centering and immobilization of the head and for the accurate projection of the rays. Third, each exposure should be made on the smallest film area within reason in order to keep down the size and weight of the grid apparatus.

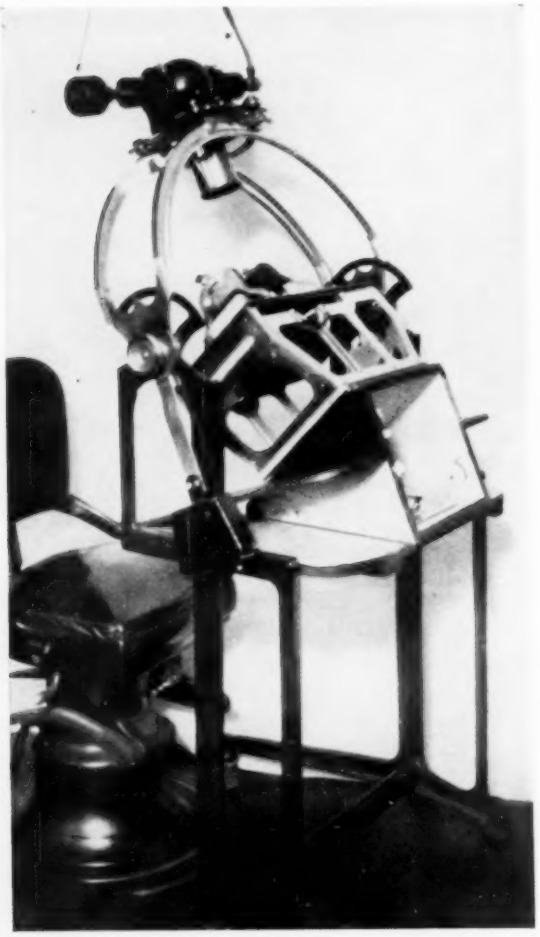


FIG. 1. General view of head stand, arc-design tube support and sinus unit.

Considerable time was spent on the drawings and on preliminary tests. It was decided that with the average patient sitting comfortably in the slightly bowed position the brow would be 41 inches from the floor. The forearms would comfortably rest some 6 or 8 inches below this level and preferably on an inclined plane with hands higher than elbows. It was found that half an 8″ × 10″ film was large enough to accommodate any of the standard sinus exposures.

1. A *flat grid* was first built to cover an area $5 \times 6\frac{1}{4}$ inches only. This area centers over one end of an 8″ × 10″ film in cassette by Buck, or one measuring $9\frac{1}{4} \times 11\frac{1}{4} \times 5/8$ inches. The unexposed half of the film is protected by lead and cannot be exposed without removal and reversing ends.

A grid ratio of 1 to 4 was selected arbitrarily because the sinus problem does not call for the highest ratio and because the grid can be made $\frac{1}{4}$ inch thick, the strip spacing of 1/16 inch being convenient. The scattered efficiency of this ratio grid is rated by Wilsey at 83 per cent. Its thinness lends itself to low patient-film distance thus favoring good definition at operating distance as low as 20 inches. The actual patient-film distance obtained was $\frac{1}{2}$ inch, made up of the grid, the cover, the protective lead, and the clearance spaces.

* This is the fourth of a series of articles on diaphragming roentgen rays. The fifth article will appear in the July number of the Journal.—ED.

The actuating mechanism was adapted from a stock grid which used a pair of extension springs with traction regulated by oil cylinder and piston. The bearings are plain but specially machined. Upon test the grid motion is nearly perfect. The maximum stroke is a bit over 3 inches but signals operate at points 1 inch either side of the 0 position. The center for operation and for convergence of grid strips lies 20 inches from grid center. The actual size of grid complex is $6\frac{1}{4} \times 10$ inches. The entire top of the grid apparatus measures $9\frac{1}{4} \times 17\frac{1}{2}$ inches. It is thus no wider than the cassette.

II. The *grid housing* is of cast aluminum, designed 8 inches deep so as to provide

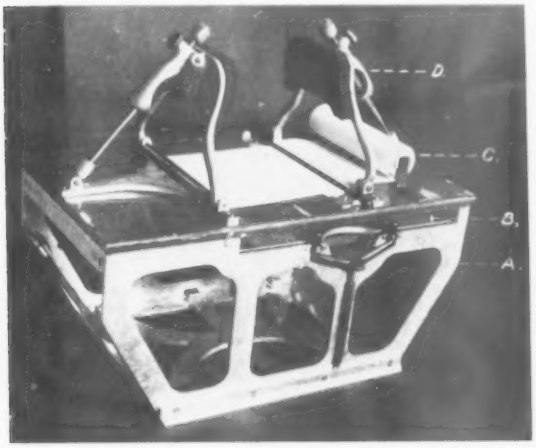


Fig. 2. Sinus grid unit with housing; dimensions of top $9\frac{1}{4}$"$\times 17\frac{1}{2}$". A. The housing. B. Space for 8" $\times$10" cassette. C. Sanitary paper roll. D. Head clamp.

hand room for manipulating the grid during the spring extension stroke and for general access to the mechanism. The release of a simple trigger starts the grid in motion.

The ends of the housing taper toward the bottom to fit a separate base plate about $9\frac{1}{4} \times 12$ inches. Side flanges allow it to slide on and off this base plate when it is desired to exchange the sinus grid for one or another special head unit. Because certain of these units must be rotated through 180° between exposures the base plate is mounted on a swivel.

Fig. 3. Placing head in position.

This swivel base plate is mounted at an angle of 45° on the top of a horizontal platform supported by the side members of the stand.

III. The *stand* itself is built from cast iron side frames rodded across for rigidity. The side frames extend up to carry a double overhead arc designed to support the tube carriage. The arcs are designed to a radius of 16 inches so that the tube 4 inches above operates at a radius of 20 inches. The arcs are mounted to move themselves about an axis of the same radius. The center line of the grid apparatus coincides with this

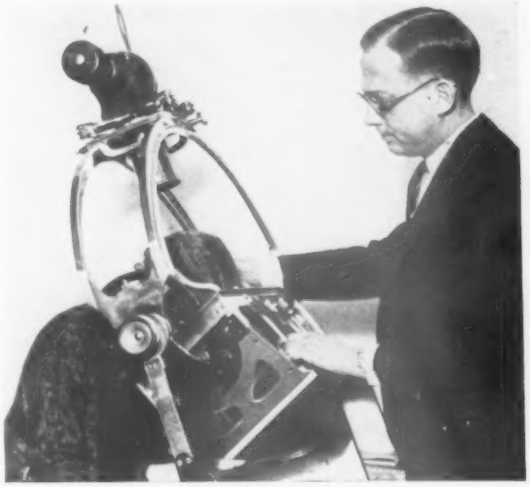


Fig. 4. The head is directly under the operator's eye.

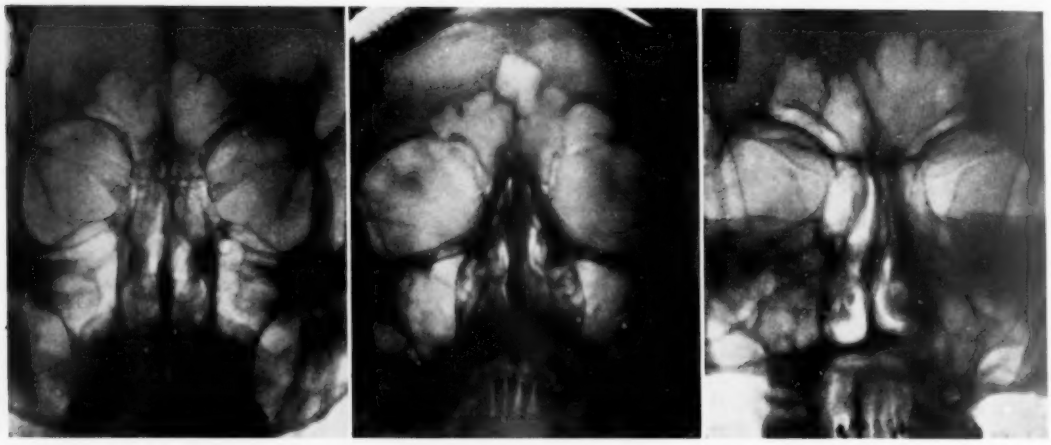


FIG. 5. Showing scope and technical result in three commonly used anterior views.

axis for arc rotation so that wherever the tube carriage is placed on the arc and whatever the rotation of the arc itself, the central ray must fall on a point at the center of the grid. The arcs are counterbalanced and may be locked in any position by a simple hand screw.

There is no provision for raising or lowering the stand for adjustment to the height of a sitting patient but this is accomplished by the supplementary use of an old dental chair stripped down to the seat and elevating mechanism. This permits a rather light rigid construction in the stand and arcs.

The platform supporting the grid apparatus is provided with suitable rests at the sides for the patient's forearms so that in the slightly bowed position the body is fairly stable. After placing the patient's head upon the grid cover it is clamped in position by the side pressure of adjustable broad plates covered with sponge rubber. This gives equally good fixation in the Caldwell and in the Waters position.

The tube carriage may slide along the arc to points 30° above the horizon. It swivels at the base and has a stereoscopic shift incorporated above the swivel so that the shift can take place at any desired angle. A radiator type tube is mounted in a barium shield.

IV. *Flexibility* of the apparatus is possible because of the wide range of tube movement. Accuracy in the projection of rays is assured by the arc type of construction, the arcs being calibrated on their faces and near their points of rotation. Adjustment of the patient's head is very simple because it lies at a most convenient level right under the operator's eye. There has been no trouble in getting the sinuses well centered in the half of an 8″×10″ film.

V. The *patient's position* is such that even if the neck is short or the bust prominent no part of the body can touch the apparatus except the head, the forearms and the feet. A side view of the apparatus shows everything cut away in front of the chest. This prevents the head movements caused in most forms of sinus apparatus by the impingement of chest on some portion of the stand.

VI. In our *sinus routine* six exposures are made on three 8″×10″ films. A first pair of stereos is made in approximately the Caldwell position; a second pair of stereos is made in the Waters position; a fifth projection is made vertically down through the sphenoids and the sixth is a simple lateral exposure. Although attention to the grid increases the number of operations, we find that exposure and positioning are so simplified that it takes no longer to do this set than a former set of three or four without grid. The accompanying illustrations give a fair idea of the apparatus.

The same stand with other special grid units is employed for the grid stereo roentgenography of the mastoids, and for certain other special problems in head diagnosis. The special grid units will be described in the next issue.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.

A Textbook of Surgery. By John Homans, M.D., Assistant Professor of Surgery, Harvard Medical School. Cloth. Price, $9.00. Pp. 1195, with 513 illustrations. With a special bibliographical index and illustrations by Willard C. Shepard. Springfield, Illinois: Charles C. Thomas, 1931.

The field of Surgery has become so extensive that it requires the greatest taste and discrimination to select the facts essential to the beginner in this Art and incorporate them in a single book that is of a usable size. In order to martial all of the pertinent facts in one volume, there has been a tendency to adopt the soulless method of categorical statement, with an attendant loss of the virile, romantic flavor that forms such an integral and interesting part of this subject. Homans has succeeded not only in selecting the facts essential to the student of medicine but also in presenting the facts in a fascinating manner that cannot fail to instill interest in the mind of the beginner. The book is said to be based on the lectures given by the members of the surgical department of the Harvard Medical School but they are to be congratulated upon their editor as the style and arrangement of the chapters are uniform in excellence and interest. The arrangement of the chapters is largely according to regional surgery covering all fields of general surgery with concise chapters devoted to the surgical specialties.

Each chapter has an informal, often chatty, historical introduction, done in a manner not at all pedantic, that seems to make of the context a living, developing story rather than a dry enumeration of dead facts. Following this is a brief statement of the pertinent anatomy and physiology of the region under discussion, this in turn followed by the subject matter pertaining to pathology, diagnosis and treatment. Treatment is indicated in a general way and no effort is made to make this a textbook of operative surgery. Controversial points are not emphasized but as much of surgical treatment and its possibilities as should be the common knowledge of every one practising medicine is temperately given. The illustrations are numerous, being largely pen and ink drawings by Shepard that are graphically executed, of carefully chosen subjects, many being entirely new to surgical literature. A bibliographical index is given which should be exceedingly valuable to students in that it emphasizes and makes readily available the original sources of modern surgical practice.

The book is of a size that can be read without a reading stand, printed on thin paper, marked by page headings, making it a usable attractive volume. One might criticise it by questioning the advisability of including chapters on such highly specialized surgical fields as the eye or the nose and ear, subjects that are usually covered more at length in the medical curriculum by books devoted solely to them. On the other hand, it may be argued that the more general presentation of these subjects may have an excellent effect on the mind of the student in helping him to maintain a proper perspective on the surgical specialties.

Homans is to be congratulated on giving life and vigor to a satisfying academic presentation of the Art and Science of Surgery, one that can be highly recommended to every student of medicine.

Frederick A. Coller

Artificial Sunlight: Combining Radiation for Health with Light for Vision. By M. Luckiesh, D.Sc., Director, Lighting Research Laboratory, Edison Lamp Works—National Lamp Works, General Electric Company, Nela Park, Cleveland, O. Cloth. Price, $3.75. Pp. 254, with 65 illustrations. New York: D. van Nostrand Company, Inc., 1930.

"Progress in the scientific development of radiation therapy has been retarded by insufficient consideration and understanding of physical science on the part of investigators and practitioners. Radiant energy or radiations of all kinds—infrared, visible, ultraviolet, Rontgen—are tools which can be adequately described only by physical units such as wavelength and intensity." This statement taken from the chapter on "Infrared Radiation" can only be emphasized by every physician interested in the proper use of radiant energy. The many physical data offered by the author in

this book fill a definite gap in our literature and should prove of value to those seeking accurate information on the subject. Especially recommended are the chapters on "Solar Radiation," "Reflection of Ultraviolet Radiation," "Transmitting Media," "Infrared Radiation," "Permanency of Materials" and "Incandescent Solids." The work of Coblentz (Bureau of Standards) is given full credit and discussed at length. In the "New Era of Lighting" the artificial source of light must serve a dual purpose: provide proper light for vision, and also furnish all the beneficial rays of the summer sun.

Ernst A. Pohle

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

Erdélyi, Josef: Skull changes in increased brain pressure 821

Rose, Cassie B.: Some unusual x-ray findings in skulls 821

Granger, Amedee: A positive sign of extensive destruction of the mastoid of infants.. 822

Brailsford, James F.: The significance of the dental radiograph and its interpretation.. 822

Neck and Chest

Eberson, Frederick, Delprat, Jessie P., and Wolff, Ernst: Suspected juvenile tuberculosis; evaluation of clinical symptoms and signs 823

v. Bernuth F.: The roentgen evaluation of the size of the heart in children 823

Schatzki, R., and Hallermann, W.: On tl : isthmus stenosis (coaractation) of the aorta 824

Saul, Walter: The roentgen appearance of various forms of bronchitis 824

Balestra, G., and Ghio, A.: The roentgen picture of the lungs in valve lesions 824

Pilot, I. Mesenchymatous tumors of the lung and pleura 824

Lemarque, P., and Chaptal: Concerning a case of intrathoracic dermoid cyst 825

Arif, Chemsettin: A case of calcified hydatid cyst of the inferior lobe of the left lung.... 825

Hickey, P. M.: A method for measuring the lumen of the esophagus 825

Muzzi, Mario: An epibronchial diverticulum of the esophagus in a patient with tumor of the stomach 825

Yates, J. L., and Raine, Forrester: Induced paralysis of the diaphragm 826

Abdomen

Dyes, Otto: Aerophagy 826

Galdau, D.: Gastric ulcers of the greater curvature 826

Giuntoli, Lorenzo: Segmental toxic gastritis of the antrum 826

Dall'Acqua, V.: The roentgen picture of mobile duodenum 826

Potenza, Vito: Submesocolic stenosis of the duodenum 827

Viviani, Rodolfo: Extrabulbar ulcer of the duodenum 827

Sighinolfi, Giuseppe: A case of common ileocolic mesentery with defective rotation .. 827

Bouquet, H., and Jaubert de Beaujeu, A.: Dystopy of the large intestine, absence of the ascending colon, inversed subhepatic cecum, biliary lithiasis 828

Wolf, Arthur: The rectum and the lower sigmoid 828

Iacobovici, I., Danicico, I., and St. Jianu: Considerations and contributions to the study of biliary fistulae 828

St. Jianu: Consideration of cholecystography on the basis of one hundred examinations 828

Tixier, Baumgartner, Ronneaux and Gadreau: Calcified aneurysms of the splenic artery and splenomegaly 829

Gynecology and Obstetrics

Smokvina, Milan: Submucous myoma 829

Genitourinary System

Leb: Roentgen pyeloscopy 829

Bronner, H., Hecht, G., and Schüller, J.: Excretion-pyrlography with "Abrodil" ... 830

Tartagli, Dino: Examination of the urinary tract by means of a contrast medium given intravenously 830

Skeletal System

Cassar, A., and Jaubert de Beaujeu, A.: A new case of progressive myositis ossificans 830

Santos, Jose V.: Changes in the head of the femur after complete intracapsular fracture of the neck 831

Junghagen, Sven: On melorheostosis 832

Speed, Kellogg, and Rider, Dean L.: Experimental healing of bone after parathyroidectomy 832

Ham, Arthur W.: A histological study of the early phases of bone repair 832

Ghimus, D.: Systemic spongio-epiphyseal dystrophy 833

Swart, Howard A.: So called renal rickets.... 833

Borman, Milton C.: Bone suppuration and renal calculi in children 834

Joseph, S., and Leeser, F.: The roentgen appearance of congenital luetic bone changes 834

Klaften, E., and Priesel, R.: On the knowledge of syphilitic bone changes in congenital lues 835

Contamin, N., and Pouzet, F.: A peculiar form of hereditary syphilis of the bone in childhood 836

Davis, John S., and German, William J.: Syndactylism (coherence of the fingers or toes) 836
Agati, Dino: Bilateral Vesalius's bones of the feet 836
Spiller, Ulrich: Multiple myeloma, spondylarthritis deformans and senile osteoporosis of the vertebral column 837
Bower, John O., Clark, Jefferson H., and Davis Leon: The management of giant cell sarcoma of the vertebrae 837
Geschickter, C. F., and Copeland, M. M.: Tumors of the giant cell group 837

ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

ERDÉLYI, JOSEF. Schädelveränderungen bei gesteigertem Hirnbruck. (Skull changes in increased brain pressure.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1930, *42*, 153–182.

The author made a detailed study of the skull changes due to increased intracranial pressure. The material included 107 examinations, 78 of which were brain tumors, 5 hydrocephalus, 2 turricephaly, 6 epilepsy, 2 migraine and 14 other conditions.

The study was based purely on the roentgen appearance of the skull as evidenced in flat films, no encephalographic examination having been undertaken. Generally one must distinguish between (1) localized and (2) generalized increased intracranial pressure. (1) In the localized pressure the author studied in detail the changes: (*a*) on the base of the skull (sella turcica, sphenoidal sinus, petrous portion of the temporal bone, etc.), and (*b*) on the vault. In the latter, the alterations consisted in distortion, thinning, deformity and thickening of the tables of the skull, in increased blood vessel markings, as well as increased impressiones digitatae and juga cerebralia. (2) In generalized increased intracranial pressure, the author paid special attention to the digitate impressions and to the pacchionian grooves, making the definite statement that they must be considered indicative of increased pressure only in the presence of other clinical symptoms. The dilatation of the emissary veins, the separation of the sutures and especially the change in position of the pineal gland are often of great aid. It is advisable to take roentgenograms at various intervals so as to note if there is any progress in the changes.

In conclusion, the author states that encephalography, which results in an 8 per cent primary mortality, is not absolutely necessary for the diagnosis of increased intracranial pressure. Roentgen films of good quality, with a careful consideration of the neurologic findings, will in the majority of the cases lead to satisfactory diagnosis.

The article is illustrated with 50 figures.—*T. Leucutia.*

ROSE, CASSIE B. Some unusual x-ray findings in skulls. *Radiology*, 1929, *13*, 508–513.

The author presents skull films of three negroes, each of whom had a severe anemia. The films of the first patient showed a radial appearance in the cortex of the bone at the peripheral margin of the vault over the parietal area. Films of the second patient showed many fine radiating lines of new bone projecting vertically from the margin of the skull vault between the coronal and occipital sutures. The third patient presented a large skull. There were numerous fine projecting lines extending outward from the margin of the skull vault between the coronal and occipital sutures. For a distance of 3 cm. below the margin of the vault the parietal bone had a porous appearance with evidence of many linear markings. Each of the above patients had many sickle-shaped red corpuscles in the blood. Necropsy examination of other patients with sickle-celled anemia revealed an increase in the spongy trabeculated bone in the middle table, with hyperplasia of the leucoblastic marrow and aplasia of the erythroblastic marrow. The skulls were thick. A case of lead poisoning in which some of the red blood corpuscles were similar in shape to those found in sickle-celled anemia but in which the skull films did not present any ray-like new bone such as that present in the cases of true sickle-celled anemia is cited to show that the absence of these rays may be used in the differential diagnosis of anemia with doubtful blood findings.

Cases are discussed in which a shadow appeared in the lateral view of the skull but apparently disappeared in the anteroposterior view. In the first case a dense rounded shadow was seen in the lateral view, lying just above the skull base and between the shadows of the sella and the petrous portion of the temporal bone. There was also a rounded area of decreased density 1 cm. in diameter, defined with fair sharpness, situated in the posterior part of the parietal region. On the anteroposterior view the decreased density was distinctly seen lying a little above the left orbit. It was diagnosed as a probable congenital defect in the bone.

The lateral view of the skull of a patient who had headache showed a rounded, sharply defined area of decreased density lying in the

temporal region, with little mottling in this area. On the stereoscopic films the shadow was seen to lie on the lateral wall of the skull. It disappeared on the anteroposterior view. Palpation of the patient's skull revealed a small thickened place in the scalp which apparently caused the shadow.

A third case, a patient who had a migraine type of headache, showed on a lateral view of his skull an oval, sharply defined, uniformly dense shadow standing out distinctly in the posterior parietal region. There were slight convolutional impressions. Calcification of the pineal gland was present. The shadow did not show at all on the anteroposterior view. A faint black line about the margin of this density indicating an air space, led to further examination of the films and the patient, and what was considered to be a flat sebaceous cyst was found on the left side of the skull near the parietal eminence. Later stereoscopic views showed the shadow to lie on the skull wall and not in the interior of the skull.

These findings emphasize the value of stereoscopic films. They also show that consideration of the smallest points in each film helps the one who recognizes their significance.—*J. D. Camp.*

GRANGER, AMEDEE. A positive sign of extensive destruction of the mastoid of infants. *Radiology*, May, 1930, *14*, 495–502.

In the roentgenograms of healthy mastoids of infants three months old, four months old and six months old, only the large mastoid antrum is seen; in those of infants one year and two years of age, besides the mastoid antrum, the clear osseous substance of the mastoid can be seen. After the second year and when the child reaches three years, four years and five years, the mastoid begins to pneumatize, the cells are of the diploetic type, and the anterior wall of the lateral sinus—only slightly visible at first—becomes more distinct as pneumatization progresses.

From the foregoing roentgenographic and anatomic data Granger concludes that in roentgenograms of the healthy mastoids of infants under three years—and certainly in those under two years—the sinus wall should not be seen, because the mastoid structure overlying it is too compact, and that when it is visible, in the absence of unusual and clear pneumatization, it can only mean extensive bone destruction. His experience of the last two and a half years has conclusively demonstrated this. During that time he has studied the roentgenograms of more than 200 infants suffering with otitis media and without mastoiditis. As a result of this study he believes that it is possible to diagnose roentgenographically two degrees of mastoid pathology in infants under one year of age: (1) Infection with occlusion of the mastoid antrum by pus, or inflammatory or bloody exudate. The latter frequently is seen in hemolytic streptococcus infections and is very likely to be mistaken for simple congestion unless a culture is made. In the roentgenogram the mastoid antrum is opaque. (2) Extensive mastoid destruction, with the sinus plate exposed. In the roentgenogram the sinus wall is visible.

Three degrees of mastoid pathology in infants over one year of age can be diagnosed radiographically: (1) Infection, with occlusion. In the roentgenogram the antrum, spongy osseous structure, and cells (if any) are opaque, but the osseous structure and cell walls are still visible. (2) Infection, with occlusion and softening of the osseous structure and cell walls (if any). In the roentgenogram, beside the opacity of the mastoid, the osseous structure and cell walls are no longer clearly visible. (3) Extensive mastoid destruction, with the sinus plate exposed. In the roentgenogram, the sinus wall is visible when it should not be (infants two years old or less), or more distinctly visible and associated with the signs of infection, with occlusion and cell wall destruction. A practical advantage of this sign of extensive destruction of the mastoid is that it can be read even in very poor roentgenograms, in fact, in those in which the lesser pathological changes cannot be seen at all.

If this sign is seen, no matter how indistinctly or how blurred, in the roentgenogram of an infant two years old or less, it means extensive destruction of the mastoid with the sinus plate exposed. On the other hand, if it is not seen even in a poor roentgenogram of the mastoids of infants two years old or less, it is certain that such massive destruction of the mastoid does not exist.—*J. D. Camp.*

BRAILSFORD, JAMES F. The significance of the dental radiograph and its interpretation. *Brit. J. Radiol.*, Jan., 1930, *3*, 19–23.

Any foci of chronic sepsis in bone from which toxins are being absorbed leads to definite changes in the bone surrounding the lesion and

this can be shown on a roentgenogram. Particularly is this true in connection with septic teeth. Teeth which do not show changes on a good roentgenogram and which are not painful are not the source of chronic toxic absorption. The roentgenogram may also provide some useful additional knowledge in the case of acute septic foci but it may not show any changes in such conditions.—*F. K. Alexander.*

NECK AND CHEST

Eberson, Frederick, Delprat, Jessie P., and Wolff, Ernst. Suspected juvenile tuberculosis; evaluation of clinical symptoms and signs. *Am. J. Dis. Child.*, Oct., 1930, *40*, 753–770.

This paper is an attempt to evaluate the significance of groups of symptoms and signs commonly observed in children, particularly among those suspected of having tuberculosis, and to compare the observations, singly and in combination, in terms of presumably significant clinical groupings. The study brought out the fact that there was little or no difference between a group with positive and a group with negative tuberculin reactions, as judged by nine symptoms and ten clinical signs under consideration. The greatest difference between the two groups seemed to be in terms of the nine roentgen observations that were studied, namely, hilus calcifications, increased lung field markings, enlarged bronchial lymph nodes, thickened interlobar pleura, peribronchial infiltration, calcified bronchial lymph nodes, primary focus, thickened apical pleura, parenchymal tuberculosis. The evidence presented showed that the commonly accepted clinical symptoms and signs have no significance, except as they may be correlated with roentgenograms and the tuberculin test, when these are definitely positive for tuberculosis. As a diagnostic criterion, roentgenograms in conjunction with the tuberculin test were unquestionably of diagnostic value. Certain roentgen signs occurring alone, appeared to have no critical value for diagnosis, although such observations have been considered in the past as pathognomonic. According to McPhedran, calcification of the lymph nodes can be recognized only as shadows having a granular appearance. Furthermore, the increase of perihilar shadows is due, not to enlargement of the bronchial lymph nodes, but to the pulsation and vibration of the arteries, giving an appearance that has been interpreted erroneously. The authors observe that it was interesting to note the remarkable correlation between certain roentgen observations and physical signs, such as dullness of the manubrium sterni and paravertebral areas and D'Espine's sign. These observations, however, were not related to the presence of tuberculosis, and indicated in a striking manner the fallacy of drawing conclusions from physical observations and clinical symptoms without careful roentgen studies and the tuberculin test. This study emphasizes the results of a previous analysis by Wolff and Stone of a series of negative tuberculin reactors. They concluded that a diagnosis of tuberculosis could not be based on the observations of localized increased markings of the lung or of the axial shadows. They found no calcifications, no enlargement of bronchial lymph nodes and no localized pulmonary infiltrations. In terms of these modern concepts, such as the work of Wolff and Stone, McPhedran and others, an explanation is found for the infrequent pathologic evidence of tuberculosis at autopsy as compared with the diagnosis made on the basis of roentgenograms of the chest. It is significant, the authors state, from their own study, that interpretations of roentgen evidence must depend not only on the occurrence of individual roentgen observations, but on their occurrence with other signs and symptoms. —*R. S. Bromer.*

v. Bernuth, F. Zur Beurteilung der Herzgrösse des Kindes nach dem Röntgenbild. (The roentgen evaluation of the size of the heart in children.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1930, *42*, 368–371.

The author advises the following formula for the evaluation of the size of the heart in children:

$$\frac{\text{body length} \times \text{transverse pulmonary diameter}}{\text{heart area}}$$

In practice, a teleroentgenogram of the heart is taken at a distance of 1 meter 50 cm. and the height of the child is measured. From the teleroentgenogram, the transverse diameter of the thorax and the area of the heart silhouette are figured. In case one does not possess a planimeter, the heart area may be calculated according to the procedure of Moritz by multiplying the longitudinal and the transverse diameters of the heart.

By using the above formula the quotient of

the normal heart varies between 30 and 47. If the quotient is less than 30 one may assume an enlargement of the heart, whereas if it is greater than 47 one may diagnose a small heart. If the Moritz procedure is used for the calculation of the heart area, the constant of the above formula will vary between 23 and 35 in a normal child.

In infants the quotients are somewhat smaller (from 29 to 44 for the above formula and from 22 to 33 with the Moritz procedure), this being due to the fact that the heart of an infant is large in proportion to the rest of the body. A detailed article on this subject will be published by the authors in *Ztschr. f. Kinderh.*—*T. Leucutia.*

SCHATZKI, R., and HALLERMANN, W. Über die Isthmusstenose der Aorta. (On the isthmus stenosis (coarctation) of the aorta.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1930, *42*, 324–333.

The authors describe in lengthy detail a case of stenosis of the aortic isthmus in a boy fifteen years of age. The stenosis which clinically led to a secondary dilatation of the ascending aorta with an aneurysm proximal to the stenotic orifice produced the following roentgenologic signs: enlargement of the left ventricle, dilatation of the ascending aorta, small aortic knob with slow, sluggish pulsation, very active fast pulsation of the ascending aorta, deepening of the sulci costalis as a result of dilated intercostal arteries, prestenotic aneurysm, non-visualization of the aortic shadow in the transparent zone of the trachea, and finally, secondary complications of the heart (vitia, congenital malformations, etc.). The article is illustrated with several roentgenograms, illustrative diagrams and sphygmograms.—*T. Leucutia.*

SAUL, WALTER. Bronchitisformen im Röntgenbild. (The roentgen appearance of various forms of bronchitis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1930, *42*, 223–233.

The intrathoracic shadows observed in case of bronchitis may be due: (1) to filling of the bronchi with secretion; (2) to atelectasis, and (3) to circumscribed emphysema. In the presence of secretion or pus, the large bronchi appear in the form of trunks, the bronchi of medium size give an uncharacteristic picture, while the bronchioles lead to a mottling of the lungs. The so-called bronchitis deformans described by Schmorl can occasionally be well demonstrated on the roentgenogram. The author observed such a case and reproduces both the roentgen films and the pathologic specimen. In case of congestion of the lungs the appearance of bronchitis is of no significance.—*T. Leucutia.*

BALESTRA, G., and GHIO, A. Sul quadro radiologico polmonare nei vizi valvolare del cuore. (The roentgen picture of the lungs in valve lesions.) *Radiol. med.*, June, 1930, *17*, 653–675.

The most frequent roentgen finding in heart lesions is a reinforcement of the shadow at the roots of the hilus. In other cases there is diffuse turbidity of the whole lung field and signs that look like those of an infiltration at the base or a pleural effusion, which may be associated with other signs of decompensation. The roentgen picture therefore in heart disease in general is hardly sufficient to show the nature of the disease or the functional strength of the heart muscle.

But in lesions of the valves, particularly mitral lesions, there is a picture which the authors have not seen described before. It consists of little round opaque spots from the size of a pinhead to that of a grain of wheat scattered over the lung fields. They are chiefly at the base of the lungs and the apices are intact, and they are more numerous in the right lung than in the left. Roentgenoscopy is not sufficient to show them clearly but a roentgenogram is required. Often on screen examination there is only uniform decreased transparency. These spots can be differentiated from those of miliary tuberculosis by their localization; in miliary tuberculosis the apices are affected also and the left lung may be affected as much as or more than the right. Roentgen examination of the lungs is particularly important in hemoptysis in showing whether the hemoptysis is circulatory in origin or not.—*Audrey G. Morgan.*

PILOT, I. Mesenchymatous tumors of the lung and pleura. *Radiology*, April, 1930, *14*, 391–399.

Five mesenchymatous tumors are reported—one chondroma, two fibromas, one fibromyoma, and one fibrosarcoma. With the exception of the chondroma, these tumors are highly vascular, and show great tendency to hemorrhage and necrosis.

In 3 of the cases reported the tumors were

almost free in the pleural cavity and, in spite of necropsy and histologic examination, the origin could not be exactly determined as being primary from the lung or from the pleura.

From the locations and the well-defined capsules, the tumors should be considered as removable by surgical operation. The author's observations would seem to indicate that, like primary carcinomas of the lung, primary mesenchymatous tumors may be increasing in frequency.—*J. D. Camp.*

Lamarque, P., and Chaptal. A propos d'un cas de kyste dermoïde intrathoracique. (Concerning a case of intrathoracic dermoid cyst.) *J. de radiol. et d'électrol.*, Nov., 1930, *14*, 592–597.

The roentgenologic as well as the clinical aspects of intrathoracic dermoid cyst are discussed.

The interesting features of the case published are that several teeth could be roentgenologically demonstrated within the shadow of the tumor mass and that the tumor had perforated into the bronchus producing a fistula with secondary infection.

A detailed review of the literature, a bibliography of 71 articles being included, revealed that this constituted the 168th case published. —*T. Leucutia.*

Arif, Chemsettin. Un cas de kyste hydatique calcifié du lobe inférieur du poumon gauche. (A case of calcified hydatid cyst of the inferior lobe of the left lung.) *J. de radiol. et d'électrol.*, Sept., 1930, *14*, 506.

Brief case report of an unusual calcification of the left lower lung which was thought to be due to a calcified hydatid cyst. The heart was displaced to the right.—*T. Leucutia.*

Hickey, P. M. A method for measuring the lumen of the esophagus. *Radiology*, 1929, *13*, 469–471.

The advantages and disadvantages of examination of the esophagus by means of sounds, bougies and esophagoscopy are discussed briefly. The author considers esophagoscopy the method which gives the most information, but it is attended with occasional risks due to the wounding of the esophageal mucous membrane, and in occasional cases with cervical arthritis the passage of the rigid tube is either extremely painful or impossible. Roentgen examination of the esophagus with an opaque suspension is the method which is attended with the least discomfort to the patient and which usually gives a considerable amount of information. Its main disadvantage is that it does not allow the demonstration of early changes in the esophagus.

Hickey reports a method which permits the demonstration of slight changes in the lumen of the esophagus in a manner accompanied with a minimum of discomfort to the patient, namely, by having the patient swallow bougies of soft gelatin in which barium sulphate has been incorporated and observing them under the fluoroscope. The preparation of the bougies is described. The patient swallows them, beginning with the smaller sizes, until the larger size is seen to pass into the stomach or until an obstruction is met. The advantage of these gelatin plugs over the barium-filled hard capsules is that if an obstruction is met the patient can swallow a little warm water which will liquefy the gelatin and allow it to pass down.

By this method early changes in the lumen of the esophagus can be detected, thus giving the hope that therapeutic measures may be more successfully employed. The lumen of the esophagus at any particular point can be accurately measured by attaching a thread to the bougie so that it can be stopped at any point in the esophagus, raised or allowed to go on down. By the above procedure Hickey has been able to detect slight narrowings of the esophagus at an early stage, and he feels that a negative diagnosis can be returned with greater certainty than by other measures.—*J. D. Camp.*

Muzii, Mario. Su di un diverticolo epibronchiale dell'esofago in soggetto portatore di neoplasma gastrico. (An epibronchial diverticulum of the esophagus in a patient with tumor of the stomach.) *Radiol. med.*, July, 1930, *17*, 802–808.

The author reviews the opinions in the literature on the etiology of diverticula of the esophagus and discusses their clinical and roentgen symptoms. The roentgen diagnosis of the condition is not difficult if the examination is made with care.

He then describes a case of epibronchial diverticulum of the esophagus which he diagnosed in a patient sent to him for confirmation of the clinical diagnosis of tumor of the stomach. The examination confirmed the diagnosis, showing a jagged irregularity for about 15 cm. along the

lesser curvature of the stomach. It also showed a round protrusion in the middle part of the esophagus the size of a bean, situated on the anterior surface of the esophagus at the level of the manubrium of the sternum. Its outline was perfectly smooth and it communicated with the esophagus by quite a large opening. It was visible during the whole time of deglutition but after deglutition stopped only a small residue of barium remained in it. The esophagus above and below it was perfectly normal and deglutition took place normally. The diverticulum had never caused any symptoms. The duodenum was normal. The author thinks the diverticulum must have been congenital as there was no apparent cause for it.—*Andrey G. Morgan.*

YATES, J. L., and RAINE, FORRESTER. Induced paralysis of the diaphragm. *Arch. Surg.*, Oct., 1930, *21*, 666–678.

The authors describe the technique for inducing paralysis of the diaphragm, which can be done safely and with little discomfort. One can produce transient, temporary or permanent unilateral or bilateral paralysis of the diaphragm which act as natural protective responses to the more acute pleuro-pulmonary irritations. Experimentally and clinically it has been proved that the paralysis of the domes may be beneficial or detrimental. The benefits are an increment in pleuro-pulmonary powers of resistance, defense repair, and restriction, in dissemination of noxious products, bacteria and tumor cells. It makes thoracoplasty and thorocotomy simpler and easier. The detriments are a reduction in vital capacity, either transient, temporary, or permanent.—*E. P. Pendergrass.*

ABDOMEN

DYES, OTTO. Aerophagie. (Aerophagy.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1930, *42*, 364–368.

The author describes a case of aerophagy occurring in a man twenty-five years of age, who suffered from nervous dyspepsia, recurrent hernia and periappendicular adhesions. The passage of air from the stomach into the duodenum and intestine was observed roentgenologically. The case demonstrates that aerophagy in neuropathic individuals is, as a rule, associated with other abdominal affections.—*T. Leucutia.*

GALDAU, D. Ulcerele stomacale ale marei curburi. (Gastric ulcers of the greater curvature.) *Cluj. med.*, Oct., 1930, *11*, 503–506.

After a detailed review of the literature the author arrives at the conclusion that ulcers of the greater curvature are rather rare. For this reason he reports in detail 2 of his own cases. In the first there was a penetrating ulcer into the spleen, while in the second a duodenal ulcer (without stenosis) was associated with an ulcer of the greater curvature. The roentgenograms are reproduced.—*T. Leucutia.*

GIUNTOLI, LORENZO. Gastrite tossica segmentaria dell'antro. (Segmental toxic gastritis of the antrum.) *Radiol. med.*, July, 1930, *17*, 853–856.

A patient seventeen years of age came for treatment with the clinical picture of complete stenosis of the pylorus. Two months before he had attempted to commit suicide by swallowing a dilute solution of sulphuric acid on an almost empty stomach. He had not eaten anything but a cup of coffee and a little bread. He said he had diluted 20 c.c. acid in about 100 c.c. water. He immediately vomited and the next day had gastric pain and bloody vomiting. The acid had not caused any injury of the mucous membrane of the mouth, pharynx, esophagus or upper and middle part of the stomach or the duodenum but there had been an ulcerous antritis which had caused cicatrization and total stenosis of the region.

It is rather hard to explain these facts. The action of a caustic is known to depend on the intensity of its causticity and the time of its action. The author thinks in this case there was a rather complex mechanism of diastaltic arcs which closed the proximal and distal ends of the antrum and retained the caustic in this region for a long time.—*Audrey G. Morgan.*

DALL'ACQUA, V. Gli aspetti radiologici del duodeno mobile. (The roentgen picture of mobile duodenum.) *Radiol. med.*, July, 1930, *17*, 781–802.

Mobile duodenum is not an unusual anomaly; according to recent statistics it constitutes more than 0.5 per cent of all cases studied roentgenologically. The author describes and illustrates 7 cases of mobile duodenum which he himself has studied within the last year. He begins by differentiating the different types of mobile duodenum: (1) partial mobility which

involves only the first portion of the duodenum and the beginning of the second part, that is to say, the supra-mesocolic part, and (2) total mobility which involves the whole of the duodenum.

When there is partial mobility the roentgen picture may be that of a double festoon or there may be a complete loop above the fixed point in the descending portion. When all the supra-mesocolic part is free the duodenum appears inverted, that is, instead of being open upward it is open downward. The course of the duodenum is anomalous when the abnormal mobility is accompanied by other factors, such, for example as an elongation of the hepato-duodenal ligament or a ptosis of the liver. The elongation of the first portion of the duodenum which is sometimes seen in these cases is important in making the roentgen diagnosis.

But when there is total mobility the appearance of the duodenum may be almost normal, and this makes diagnosis difficult. In the majority of cases, however, the duodenum is all on one side of the midline and is accompanied by anomalies in position of other abdominal viscera. The author describes one case in which in addition to mobile duodenum there was inversion of the stomach and liver with persistence of the common mesentery and mobility of the cecum.

In some cases mobile duodenum does not cause any symptoms but in others the mobility may cause stenosis with all its sequels. Gastritis, duodenitis, periduodenitis and gastric ulcer are frequently seen in mobile duodenum. —*Audrey G. Morgan.*

Potenza, Vito. Stenosi duodenale sottomesocolica. (Submesocolic stenosis of the duodenum.) *Radiol. med.*, June, 1930, *17*, 675–683.

The patient was a child three and a half years of age. Soon after birth she began to have vomiting and constipation. These symptoms became so much worse that she was finally brought for roentgen examination. The examination showed stenosis of the third portion of the duodenum with great dilatation of the part of the duodenum above it and marked motor insufficiency of the stomach. Operation confirmed the diagnosis, showing stenosis of the third portion of the duodenum from peritonitic adhesions with great dilatation of the stomach and the duodenum above the stenosis. A posterior gastroenterostomy was performed and the child recovered quickly and gained weight rapidly.

This child's development was almost normal in every way though she showed Holzknecht's classical picture of submesocolic stenosis of the duodenum. The case shows the importance of roentgen examination in making a differential diagnosis between functional conditions and those due to congenital or organic changes.—*Audrey G. Morgan.*

Viviani, Rodolfo. Contributo alla conoscenza dell'ulcera extrabulbare del duodeno. (Extrabulbar ulcer of the duodenum.) *Radiol. med.*, June, 1930, *17*, 698–734.

The author reviews all that he has been able to find in the literature on the subject of extrabulbar ulcer of the duodenum, showing how little there is of value either in clinical or roentgen study of the subject. He describes 4 cases, out of about 100 cases of ulcer of the duodenum that he has had. They are illustrated by roentgenograms. The clinical and roentgen study of these cases was confirmed by operation and in one case by autopsy. Extrabulbar ulcer does not present clinical symptoms that are characteristic enough to differentiate it from ulcer of the bulb but there are some well-marked roentgen signs by which it may be differentiated. The roentgen signs consist of niche, and deformity of the duodenum consisting of stenosis of the lumen above and below the niche, with disappearance of the folds and spasm opposite the ulcer. This may be organic or functional. Even if there is no niche, which is the most important sign, there are other signs which suggest ulcer but they must be considered in connection with the clinical signs. The roentgen signs are the same in ulcer of the stomach, the bulb of the duodenum and extrabulbar ulcer, showing that the intestine reacts in the same way in different locations with the exception of some differences due to local anatomical conditions. As extraduodenal ulcer of the duodenum is not so rare as has been supposed the roentgenologist should make a very careful study of the whole duodenum if there are any signs of ulcer.—*Audrey G. Morgan.*

Sighinolfi, Giuseppe. Un caso di "mesenterium commune ileo-colico con mancata rotazione." (A case of common ileo-colic mesentery with defective rotation.) *Radiol. med.*, June, 1930, *17*, 734–748.

The author describes a case in a man aged forty-six, and in connection with it gives a detailed embryological description of the normal development of Toldt's umbilical loop and of the pathogenesis of the defects of intestinal rotation which lead to such conditions, illustrating the different embryological periods and arrests of development with the excellent figures taken from N. Dott's work. He gives the details of the roentgen findings in his case of common ileo-colic mesentery with lack of rotation, confirmed by roentgen examination by mouth and rectum, giving 6 films illustrating his findings. He thinks that the intestinal dyspepsia from which the patient had suffered for two decades and its recent complication by gastric symptoms were due to vagotonia and the dysfunction of the vegetative nervous system was brought about by the constitutional anomaly of the intestine.—*Audrey G. Morgan.*

Bouquet, H., and Jaubert de Beaujeu, A. Dystopie du gros intestin, absence du colon ascendant, caecum inversé sous le foie, lithiase biliaire. (Dystopy of the large intestine, absence of the ascending colon, inversed subhepatic cecum, biliary lithiasis.) *J. de radiol. et d'électrol.*, Sept., 1930, *14*, 501–505.

This is a case report of a man forty-six years of age who came to examination for suspected gallstones. By administering a barium meal a total absence of the ascending colon with a subhepatic position of the cecum was found. The roentgenograms as well as some drawings illustrating the operative findings are included. The condition is a developmental anomaly.—*T. Leucutia.*

Wolf, Arthur. Das Rektum und das untere Sigmoid. (The rectum and the lower sigmoid.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1930, *42*, 358–363.

The rectum is visualized roentgenologically either by insufflation of air the pelvis being elevated or by barium enema in an erect position. The pars perinealis is never filled. The pars sacralis appears in the lateral view in the form of a banana with smooth contours, while in the anteroposterior view it gives the impression of haustration, simulating an ampulla. It is the author's opinion that a true ampulla does not exist, the lumen of the rectum being equal throughout. The sigmoid begins at the third sacral segment, showing a horizontal loop formation to the right. The upward displacement of this loop usually indicates pelvic tumor or a marked increase in the tonus.—*T. Leucutia.*

Iacobovici, I., Danicico, I., and St. Jianu. Consideratiuni si contributiuni la studiul fistulelor biliare. (Considerations and contributions to the study of biliary fistulae.) *Cluj. med.*, Oct., 1930, *11*, 479–486.

The authors describe 3 unusual cases of biliary fistula in which roentgen examination with lipiodol led to the correct diagnosis. In connection with these 3 cases the value of lipiodol injection in the exploration of the biliary passages is discussed in detail.

If at the first operation the true nature of the lesion of the biliary ducts cannot be determined, and simply a drainage of the gall-bladder is performed, subsequent injection of the gall ducts with lipiodol becomes not only helpful but directly indispensable. Such a procedure, in addition to the fact that it aids in properly diagnosing the lesion (site of obstruction, stenosis, etc.), also permits a control of the proper drainage in cholecystotomy and of the T-drainage in choledochotomy, thus indicating the best moment for the suppression of the drainage and a new operative intervention.

The injection is made with the aid of a cannula, inserted directly into the fistular orifice. A manometer is used for the control of the pressure. Of all opaque media lipiodol has given the best results, the quantity used being 200 c.c. at the most. Since the evacuation of the biliary passages takes about five to six minutes, the injection may be repeated at the end of that time.

A reduced capacity or a delayed emptying of the gall ducts indicates obstruction. The surest sign of an obstruction, however, is a lacunar shadow representing a stone. If no such shadow can be demonstrated, the diagnosis is based purely on the secondary signs such as history, capacity of the gall-bladder, quantity of the opaque substance evacuated in the duodenum, state of distention of the large biliary ducts and the evacuation time of the biliary system. The only contraindication to the method is infection.—*T. Leucutia.*

St. Jianu. Consideratii asupra cholecistografiei in legătură cu una sută examinări. (Consideration of cholecystography on the basis of one hundred examinations.) *Cluj. med.*, Nov., 1930, *11*, 560–565.

One hundred cases were examined by chole-

cystography (by means of sodium tetraiodophenolphthalein) during the past few years at the University of Cluj, 10 by the oral and 90 by the intravenous method. Seventy cases were controlled by operation, these being discussed in detail. In 14 cases there was a normal opacity and form with good filling and evacuation of the gall-bladder, the lesions found at operation in all these instances being extrabiliary; in 16 cases there was normal opacity but irregular form and disturbed emptying of the gall-bladder, the lesions found at operation being one retroperitoneal tumor and 15 adhesions. In 12 cases there was lessened opacity with disturbance of evacuation, the lesions found at operation being chiefly chronic cholecystitis. Finally, in 28 cases there was complete lack of filling, the lesions found at operation being calculi in 23 cases, and hydatid cysts in 5 cases.

The fact that hydatid cysts led through mechanical pressure on the gall ducts to a complete lack of filling in cholecystography is interesting and must be borne in mind. In 2 of the 5 cases the presence of calcification of the cyst wall made a preoperative diagnosis of hydatid cyst possible, while in the other 3 cases the correct diagnosis could be made only at the time of operation.—*T. Leucutia.*

Tixier, Baumgartner, Ronneaux and Gadreau. Anévrismes calcifiés de l'artère splènique et splénomégalie. (Calcified aneurysms of the splenic artery and splenomegaly.) *Bull. et mém. Soc. de radiol. méd. de France*, Oct., 1930, *18*, 349–351.

The authors describe a very unusual case of aneurysm of the splenic artery observed in a woman forty years of age who came to examination with a large spleen.

The roentgenogram of the upper abdomen revealed the presence of calcifications in the left upper quadrant, without permitting the establishment of the correct preoperative diagnosis. The possibility of hydatid cyst, calculi of the spleen, calcified tuberculous foci of the spleen and calcified mesenteric glands was considered.

At operation two large saccular aneurysms, partially calcified, of the splenic artery were found. The condition is exceedingly rare.—*T. Leucutia.*

GYNECOLOGY AND OBSTETRICS

Smokvina, Milan. Das submuköse Myom. (Submucous myoma.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1930, *42*, 219–223.

The author had performed up to October, 1929, 480 hysterosalpingographies, in 130 of which were found myomas with 50 of the submucous type. In the beginning, it was the author's impression that the diagnosis of a submucous myoma is relatively easy but later he found that a polyp of the uterine mucosa as well as placental remains in the uterine cavity may give similar appearances. In this article the signs which might permit a differential diagnosis between these conditions are discussed. The conclusion is reached that a differentiation between submucous myoma and polyp of the uterine mucosa is entirely impossible and that a differentiation from placental remains can be made only by taking into account the history of the case as well as other clinical symptoms. The roentgen diagnosis of a submucous myoma is especially difficult when the myoma is very small or very large, when there are several myomas and when the myoma is associated with some secondary lesion as, for example, retroflexion, etc. The author never observed a myoma associated with pregnancy.—*T. Leucutia.*

GENITOURINARY SYSTEM

Leb. Die Röntgenpyeloskopie. (Roentgen pyeloscopy.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1930, *42*, 291–311.

Roengten pyeloscopy is indicated: (1) in the diagnosis of functional disturbances of the renal motility in an organically normal kidney such as: (*a*) paralysis of the musculature of the kidney pelvis due to injury of the lumbar spine, this resulting in a retention of the opaque medium in the pelvis for a period of over five hours; (*b*) spastic contraction of the neck of the kidney pelvis due, for example, to spina bifida occulta, there being a residue of at least half of the opaque medium after thirty minutes and (*c*) atony of the kidney pelvis and ureters with a three-quarters residue after eight hours; (2) in the diagnosis of pre-hydronephritic stage, there being a slight delay in the emptying; (3) in the prognostic evaluation of the pyelitic and pyelonephritic alterations, depending on the amount of retention; (4) in the precision of diagnosis in malignant renal tumors, and (5) in the demonstration of hyperkinetic forms of urinary excretion in case of infarcts and hemorrhages of the renal parenchyma and in case of acute pyelonephritis, the emptying being completed within a few seconds.

The technique and procedure of roentgen pyeloscopy are described in lengthy detail. Umbrenal was used by the authors as the opaque medium. The article is illustrated with numerous roentgenograms and diagrams.—*T. Leucutia.*

BRONNER, H., HECHT, G., and SCHÜLLER, J. Ausscheidungs-Pyelographie mit "Abrodil." (Excretion-pyelography with "Abrodil.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1930, *42*, 206–218.

Bronner recently reported before the German Surgical and Roentgenological Societies (*Verhandl. d. deutsch. Gesellsch. f. Chir.*, April, 1930; *Verhandl. d. deutsch. Röntg.-Gesellsch.*, April, 1930) a new preparation called "abrodil" for intravenous pyelography.

Abrodil, a white crystalline powder, is the sodium salt of iodomethan sulphonic acid (I CH_2SO_3Na), and contains 52 per cent iodine organically bound. A 4 per cent solution is isotonic. It was first manufactured by Ossenbeck and Tietze. Animal experiments carried out by the authors revealed that the preparation is entirely harmless. A rabbit, for example, which received 1 gram abrodil per kilogram body weight intravenously on seven consecutive days showed no ill effects, except for a slight decrease in the hemoglobin of the blood, which might have been due to the dilution by the injected solution.

The standard dose in the human is 100 c.c of a 20 per cent solution (20 gm.). This quantity is well tolerated, giving in case of normal renal function good roentgenograms within fifteen to twenty-five minutes following the intravenous injection. In a few instances a dose as high as 50 gm. was administered without ill effects, but the roentgenograms so obtained were not superior in any way to those obtained by the injection of 20 gm. In children the normal dose is 0.3 gm. per kilogram body weight.

The only contraindication to the method is a severe functional disturbance of the kidney.

The method was tried in over 100 patients without one single accident. Some very beautiful roentgenograms (a few of them being reproduced) were obtained.

The preparation can also be used for direct pyelography in a 15 to 20 per cent sterile solution with addition of silver nitrate 1:1000 or mercury oxycyanide 1:4000.—*T. Leucutia.*

TARTAGLI, DINO. L'esame delle vie urinarie mediante un preparato di contrasto introdotta per via endovenosa. (Examination of the urinary tract by means of a contrast medium given intravenously.) *Radiol. med.*, July, 1930, *17*, 833–852.

The author describes and gives roentgenograms of 8 cases of examination of the urinary tract by means of uroselectan. This is a pyridin derivative that contains 42 per cent iodine combined organically. It is injected into an arm vein. It is perfectly tolerated. To study kidney function it is necessary to take a series of roentgenograms. Generally the maximum of elimination takes place after 20–35 minutes. Pathological kidneys generally show more rapid elimination than normal ones, or at least an irregular flow, while that of the normal kidney is uniform. Calculi are shown very well by the method. Abolition of kidney function does not seem to contraindicate its use for in one of the author's cases the kidney was reduced to the cortex filled with pus. It required only a small amount of the fluid to penetrate the numerous cavities and show the correct diagnosis. He does not believe ascending pyelography would have given as good results in this case, particularly as the ureter was irritated. The method is excellent for cystography and shows any morphological changes in the bladder.

The intravenous method is valuable in the first place because it can be practised by the roentgenologist himself; also because the medium is perfectly tolerated in even the severest cases and it is certainly better than the ascending method for uroscopic examinations for the patient can be observed for a long time and in any position. It gives better visibility of the kidney without combined technique and probably shows pictures that could not be seen with any other method.—*Audrey G. Morgan.*

SKELETAL SYSTEM

CASSAR, A., and JAUBERT DE BEAUJEU, A. Un nouveau cas de myosite ossifiante progressive. (A new case of progressive myositis ossificans.) *J. de radiol. et d'électrol.*, August, 1930, *14*, 462–464.

Gruder in 1926 was able to collect 133 cases of myositis ossificans from the literature. Since then several individual reports have been added.

Recently the authors observed a case of myositis ossificans occurring in a boy two years of age. At the age of six months tumor-like formation developed in both cervical regions leading to considerable impairment in the func-

tion of the muscles of the neck. Three months later two new nodules appeared in the occipital region. All these formations spontaneously disappeared within a period of three months but the functional disturbance persisted.

When brought to the authors the patient showed a peculiar position of the neck with nearly complete loss of function. He could turn his head to the side only by turning his whole body. The roentgen examination revealed two opaque bands in the region of the sterno-cleido-mastoid muscles, the osseous production extending also from the axilla downwards, on the right side to the eighth and ninth ribs and on the left side to the tenth dorsal vertebra. The appearance was that of a progressive myositis ossificans.

The patient was a heredosyphilitic and there is no doubt that lues was the etiologic factor. According to the authors this represents the 144th case described in the literature.—*T. Leucutia.*

Santos, Jose V. Changes in the head of the femur after complete intracapsular fracture of the neck. *Arch. Surg.*, Sept., 1930, *21*, 470–530.

The author calls attention to the blood supply of the femoral head and neck, stating that the main supply comes from the ligamentum teres and from the capsular arteries. Changes which are noticed following complete intracapsular fractures are primarily dependent upon the preservation or loss of this supply, and determines its subsequent vitality. If the vessels are adequate the head remains alive, but if inadequate it undergoes necrosis.

When the head remains alive there may be either bony union or non-union of the fracture. Bony union occurs in a large percentage of cases if the fracture is well reduced and immobilized by the Whitman abduction method or if it is put at rest in case of impaction. When the head survives and union occurs, it undergoes a trophy of disuse during the period of immobilization and subsequent disability and regains its normal bony density with the restoration of function. When there is non-union the head remains permanently atrophic.

In cases of inadequate nourishment of the proximal fragment through the round ligament, the bone, bone marrow and cartilage become necrotic. Bony union may follow in case of efficient reduction and immobilization or in case of impaction. In this event the head is gradually invaded by tissue growing across the healing fracture from the distal fragment, and in some cases from the hypertrophied round ligament, the dead bone, bone marrow and cartilage are absorbed and more or less completely replaced by irregularly distributed new bone, bone marrow and fibrous tissue. The weight-bearing portion of the head may collapse before the result, but the prolonged avoidance of weight bearing may prevent this occurrence and a good functional result may be obtained.

Since the state of nutrition of the head of the femur has direct bearing on the occurrence of non-union and of disintegrative changes in it and on the type of treatment to be carried out, it is of great importance to try to estimate this as nearly as possible by means of roentgenograms. If the head remains alive, it will undergo the same degree of atrophy from loss of function produced by immobization and restitution produced by return of function as occurs in the neighboring bone of the ilium and distal fragment. Consequently, the head and distal fragment show about the same degree of reduction in density at the end of the period of immobilization, and reduced density persists throughout the period of disability. In case of occurrence of bony union, there is a gradual return to original density with the full resumption of function.

In case of necrosis of the proximal fragment there is a distinct difference in density between the shadow cast by the head and the neighboring living bone at the end of the period of immobilization treatment. This difference is visible at the end of six weeks and is usually marked at the end of two and one-half or three months. The head, having lost its blood supply, has been unable to atrophy and casts a shadow of normal density while the neighboring living bone casts a shadow of reduced density as a result of atrophy of disuse. If there is non-union, the neighboring living bone continues to cast a shadow of reduced density due to the protracted disease. The necrotic head is more or less gradually invaded by blood vessels and connective tissue, but in the absence of functional stimulation there is very slow absorption of the dead bone with partial replacement by living bone. Consequently, it continues to cast a heavier shadow than the neighboring atrophic living bone for a prolonged period.

When there is necrosis of the head and bony

union of the fracture occurs, the necrotic head casts a heavier shadow than the distal shadow at the end of the period of immobilization. With the resumption of function, the tissues of the distal fragment and in some instances of the round ligament are stimulated to invade the necrotic head with resultant absorption and replacement by new bone at a much more rapid pace than occurs when there is no functional stimulation as in the case of non-union. This transformation is evidenced by an irregular reduction in density proceeding from the fracture line where the invasion is from the distal fragment and from the fovea where the invasion is from the round ligament.—*F. K. Alexander.*

JUNGHAGEN, SVEN. Sur la mélorhéostose. (On melorheostosis.) *J. de radiol. et d'électrol.*, Sept., 1930, *14*, 495–500.

In 1922 Léri and Joanni published a case of a peculiar hyperostosis involving the bones of one upper extremity. Since then 6 other cases have been added to the literature. Recently the author had the opportunity to make minute observations in an additional case.

The following were the findiings: The bones of the right upper extremity showed a line of thickening extending from the lateral border of the scapula through the entire length of the humerus and ulna and through the scaphoid, semilunar, os magnum and pisiform to the bones of the second finger and the metatarsal of the first finger. The thickened bone presented a complete loss of structure of the spongiosa, resembling in the roentgenogram the picture of marble bone. The microscopic examination of the biopsy removed from the olecranon revealed the characteristic findings of eburnification.

The peculiar distribution of the process to parts of the bones running in a straight line, of only one extremity, suggests that the condition is of a congenital nature. It is probable that through faulty disposition one of the primitive segments leads in the course of development to increased bone formation, the hypergenesic activity extending to the enchondral as well as to the perichondral and periosteal ossification. This also explains the very slow evolution of the process, the normal ossification not being complete until the third decade of life.

In the author's case there were also some articular changes, consisting in narrowing of the intra-articular space and in secondary alterations brought about by the exostosis in a manner similar to that observed in arthritis deformans.

There was no symptomatology, except for occasional vague pain accompanying certain unusual movements of the arm.—*T. Leucutia.*

SPEED, KELLOGG, and RIDER, DEAN L. Experimental healing of bone after parathyroidectomy. *Arch. Surg.*, Oct., 1930, *21*, 679–692.

The authors give a comprehensive review of the literature pertaining to the influence of parathyroidectomy on the formation of callus and healing of fractures of bones. Their protocols are given. They conclude that lack of calcification of the bones after experimental fracture in conjunction with low blood calcium led to the inference that the calcium stream was directed away from the bones after parathyroidectomy, either through this change of calcium stream, or balance, or through some still undiscovered factor, which delays the healing of fracture in experimental dogs.—*E. P. Pendergrass.*

HAM, ARTHUR W. A histological study of the early phases of bone repair. *J. Bone & Joint Surg.*, Oct., 1930, *12*, 827–844.

This paper is concerned with the origin, nature, and growth of the cells which repair a fracture, and a study of some of the purely local factors which influence the process. The work is based on a series of experimental fractures produced in the rabbit. The author also considers the phenomenon of metaplasia. He investigates the reaction of the adult bone cells and secondly, the osteogenic bone cells, to injury.

His summary follows: The adult bone cell is distinguished from the osteogenic cell which is found lining the bone in periosteum, the haversian canals, and the endosteum.

The adult bone cell was found to take no active part in the process of regeneration of bone following a fracture.

The osteogenic cells proliferate and differentiate into bone and cartilage.

Concerning the controversy regarding the existence of a specific osteogenic cell, the subject of metaplastic bone formation is reviewed. The usual method of bone repair is through the agency of these specific osteogenic cells and not by metaplasia of fibroblasts.

Two factors, the presence of a local deposit of calcium salt and a good blood supply, are of

great importance in effecting the differentiation of the osteogenic cell into bone.

Cartilage results from the growth of osteogenic cells in the absence of these two factors.

In the repair of fractures, bone and cartilage formation results from the differentiation of osteogenic cells in different environments.—*R. S. Bromer.*

Ghimus, D. Dystrophie spongio-épiphysaire systématisée. (Systemic spongio-epiphyseal dystrophy.) *J. de radiol. et d'électrol.*, Nov., 1930, *14*, 598–602.

A peculiar change of the epiphyses of the entire skeleton was observed in a boy nine years of age who came under observation complaining of pain in the articulations. The history of the case revealed that the first manifestations of the disease commenced at the age of four, with pain in the hip and knee joints. Later waddle gait and marked pain in the lumbar region developed. At the time of examination, the boy was rather small (96 cm. high), giving the impression of a child of the age of four. There was a marked shortening of both upper and lower extremities, especially of the fingers and toes. The thorax showed signs of rickets, there also being a marked accentuation of the lumbosacral lordosis.

Roentgenograms of the entire skeleton revealed the following peculiarities: At the level of all articulations the diaphyseal ends showed a spongious appearance, this leading to a swelling of the joints. The epiphyses were enormously reduced in size, especially those of the upper ends of the femora where only a spongious tissue of the neck has remained, the head and even part of the neck of the femur having entirely disappeared. A similar spongious destructive process was observed in all the vertebrae, there being a festooned irregular appearance of the bodies of all the vertebrae and a disappearance of the transverse processes of the lumbar vertebrae. The carpal and tarsal bones, as well as all the bones of the fingers and toes revealed a spongious destructive process throughout their entire length.

It is the author's contention that this condition represents a lesion hitherto undescribed. Since it cannot be placed either in the group of achondroplasias or osteomalacias, he proposes the term of "systemic spongio-epiphyseal dystrophy." The roentgenograms of the entire skeleton are reproduced.—*T. Leucutia.*

Swart, Howard A. So called renal rickets: report of a case. *J. Bone & Joint Surg.*, Oct., 1930, *12*, 876–890.

Swart states that the term renal rickets has been given to a disease entity characterized by renal insufficiency, due usually to chronic interstitial nephritis, as evidenced by albuminuria, high concentration of blood urea, and so forth, and associated with deformities of bones resembling rickets, such as knock-knee, beading of the ribs, and widening of the epiphyses.

The roentgenograms of the case reported by Swart showed a generalized process involving all the bones, characterized by atrophy, softening and thickening of the epiphyseal lines. There was a diffuse, homogeneous thickening of the skull, with a finely irregular, fuzzy appearance, similar to that seen in Paget's disease. The vertebrae were markedly flattened and widened, and there was cupping of the inferior and superior surfaces. The intervertebral spaces were much wider than normally found. There was bowing of all the long bones of both arms, with definite thickening of the periosteum. The pelvic bones were greatly distorted. The iliac crests were markedly thickened and the shape of the bones was as though some great force had pushed the pelvis in from both sides. Coxa vara was present and the femora were laterally bowed. The thorax was distorted and the ribs were close together. In the knees there seemed to be increased deposition of calcium on the diaphyseal side of the epiphyseal line, which was definite and heavy in outline, although slightly irregular. The appearance was markedly different from the irregular ossification and the woolly characteristics seen in true infantile rickets. There was no widening of the epiphysis, nor was there any suggestion of the "rotting-post" appearance which has been described as being typical of rickets. All the bones showed a general hazy mottling, with irregularly spotted, snow-flake like areas in the heads of the femur and the humerus on both sides. The clear normal outlines of the bones were missing. There was thickening of both periosteum and the cortex, and in places the cortex and the medulla were not differentiated.

The author reviews all the known reported cases and shows the rarity of the condition. He quotes Teall who distinguished two types of the disease; the rachitic type and the woolly type. The rachitic type is identical with ordinary rickets. The woolly type shows definite osteo-

porosis, increasing in severity, the trabeculae are thickened and deformities appear in the metaphyses. Ossification is irregular, there is a stippled woolly appearance and the metaphysis is not so splayed out as in ordinary rickets. Teall wrote: "In this metaphysis the bone appears to be eaten away under the periosteum, producing a roentgenographic appearance which always reminds me of a wooden post which has rotted away in the earth." In this type, too, the lesions may be asymmetrical.

In making the diagnosis of so-called renal rickets, distinction must be made from several other conditions—tumor of the parathyroid glands producing hypercalcemia and osteomalacia, late rickets, juvenile Paget's disease, and early osteomalacia. In the case of osteomalacia resulting from parathyroid tumors, bowing of the long bones occurs, accompanied by the formation of cysts and giant cell tumors, and a fuzzy, irregular appearance of the skull. The discovery and the removal of tumors of the parathyroid glands promptly reduces the concentration of serum calcium to a point at which in some reported cases, tetany appeared.

Late rickets was excluded in Swart's case because the patient had been perfectly well as far as the skeleton was concerned until the age of fifteen years, and there were no dietetic changes at that time. In addition the bony changes differed greatly from those of rickets, early or late, and were much more severe.

Juvenile Paget's disease produces thickening of the cortex and the periosteum of the shafts of the long bones, and no epiphyseal changes.

The renal factor in Swart's case would rule out osteomalacia, although softening of the bones with deformity such as occurs in osteomalacia was present.

The question of etiology is left open, although the author suggests the possibility that the renal insufficiency had stimulated the parathyroid gland to overactivity and had thus produced the skeletal changes. This is open to the criticism, however, that skeletal changes rarely accompany renal insufficiency, whereas chronic interstitial nephritis or other renal disease which produces insufficiency is frequently found, with absolutely no skeletal changes.—*R. S. Bromer.*

BORMAN, MILTON C. Bone suppuration and renal calculi in children. *Am. J. Dis. Child.*, Oct., 1930, *40*, 804–812.

The medical and surgical profession have been paying increasing attention to pathologic conditions of the urinary tract in children and the possibility of more than incidental association of bone suppuration and renal calculi. Because of this, Borman reports in great detail a case which came to autopsy. He reviews the literature of urolithiasis in children and also that of urolithiasis associated with bone suppuration or trauma. His case had an osteomyelitis of the right femur with a suppurative arthritis of the right hip-joint. Calcium phosphate calculi were found in both ureters and kidneys.

In commenting upon the case he mentions the interesting fact that the only clinical evidence of urolithiasis was the hematuria which occurred about four weeks after the onset of the illness. If urolithiasis was dependent on bony suppuration, it apparently developed rapidly. The phosphaturia and the destruction of calcified bone with its probable absorption seem significantly associated with the calcium phosphate urolithiasis. It seems unusual that such extensive calculus formation would exist without the production of renal colic. It is possible that such colic did occur in the later stages of his patient's illness when he was under the influence of sedatives and was unable to make any complaint. The small amount of pyelonephritis as revealed by the histologic examination seems insufficient to account for the production of the calculi. The pyelonephritis would seem rather to be a result of the irritant action of the calculi. Calculi are frequently found in patients suffering with fractured spines as well as in cases having bone suppuration.

He thinks the calculus formation in his case was probably definitely dependent on the osteomyelitis, and was not simply an associated incidental condition. His case and the cases previously reported in the literature would suggest the importance of always suspecting the association of urolithiasis with bone suppuration in both children and adults. Such patients should have plenty of fluid. If calculi form, the reaction of the urine should be changed.—*R. S. Bromer.*

JOSEPH, S., and LEESER, F. Kongenitale luetische Knochenerkrankungen im Röntgenbild. (The roentgen appearance of congenital luetic bone changes.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1930, *42*, 182–190.

The anatomico-pathologic changes of bone in congenital syphilis have been known since 1870 (Wegner). At the present time, nearly all investigators agree that the changes are most

pronounced from the second half of fetal life to three months after birth. They are observed most frequently in premature infants, then in still-born, and only rarely in new-born. One must distinguish the following three forms: (1) osteochondritis; (2) periostitis and (3) rarefying fibrous osteomyelitis (Pick). (1) In the osteochondritis Wegner has distinguished three stages: (*a*) the first stage, characterized by enlargement of the zone of ossification with an irregular serrated border especially towards the growing zone of the epiphyseal cartilage; (*b*) the second stage, characterized by a further enlargement of the zones of ossification, the serrated edge becoming well-demarcated and a zone of granulating tissue appearing between the zone of temporary ossification and the zone of permanent ossification, and (*c*) the third stage, characterized by increase in the size of the fibrous zone with a tendency to necrosis and fatty degeneration, often resulting in a break of continuity and even epiphyseal dislocation (Parrot). Roentgenologically in the first stage there is evidence of increased density of the zone of ossification with a dentated margin towards the epiphysis; in the second stage new transparent bands appear between the epiphysis and diaphysis, corresponding to the zone of granulation, and in the third stage there is a break of continuity in the corticalis, with partial or complete fracture, depending on the extension of the granulation into the diaphysis. The lesions are localized chiefly to the long bones, in the first instance to the distal ends of the tibia and fibula and to the proximal epiphysis of the femur, then to the proximal epiphysis of the tibia and humerus and finally more rarely to the proximal epiphysis of the radius and ulna. In a few instances the process may also extend to the ends of the ribs, to the flat bones and to the scapula.

(2) Syphilitic periostitis may appear in the form of an isolated lesion without other concomitant manifestations, as a rule, the first month after birth. One must exercise great care in its diagnosis, since antisyphilitic treatment occasionally provokes similar changes.

(3) The rarefying fibrous osteomyelitis described by Pick is rather rare. It appears either as a localized or a more diffuse process. The localized osteomyelitis is encountered chiefly in the proximal thirds of the radius and ulna.

Roentgenologically both the periostitis and the rarefying fibrous osteomyelitis give pictures which are not always characteristic.

The article is richly illustrated with roentgenograms showing various forms of the above lesions.—*T. Leucutia.*

Klaften, E., and Priesel, R. Zur Kenntnis der syphilitischen Knochenerkrankungen bei Lues congenita. (On the knowledge of syphilitic bone changes in congenital lues.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1930, *42*, 311–323.

Congenital lues leads to lesions of the bony skeleton from the fifth fetal month on. At the sixth fetal month, according to Thomson, 97 per cent of all cases of congenital lues show already marked changes, consisting of osteochondritis (with its three stages), periostitis and the so-called osteomyelitis fibrosa rareficans (Pick). These changes last until the sixth month after birth when they gradually recede, giving place to late manifestations such as hyperplastic periostitis and destructive osteitis with circumscribed gummatous foci, similar to those observed in the tertiary stage of acquired lues. Moses, in 1929, was the first to describe an osteochondritis which was observed at a later age (a girl ten and a half years old), and which he therefore called osteochondritis luetica tarda. This condition is discussed by the authors in a somewhat lengthy detail on account of its similarity to the skeletal changes which form the subject of the present article.

These changes consist of dense transverse bands of the diaphyses, at definite distances from the metaphyseal ends, of all long bones of the upper and lower extremities. The distance from the metaphyseal ends is the greatest at the distal end of the femur, and the least at the proximal ends of the radius and ulna. The width of the bands varies, being likewise greatest at the distal end of the femur and smallest at the proximal end of the radius and ulna. This variation in distance and width is explained by the difference in the developmental growth of the bones, the distal end of the femur showing the most active and the proximal end of the ulna and radius the slowest rate of growth.

The changes were, as a rule, observed in newborn and sucklings and therefore one may assume that they had already begun ante partum. It must be mentioned however that all mothers received antiluetic treatment during the last three or four months of pregnancy. Thus it is possible that the osteochondritic bands which already were present in fetal life before the in-

stitution of the antiluetic therapy were displaced with the progress of bony growth more and more towards the diaphyses the metaphyses themselves showing as a result of the treatment normal development. It is interesting that in several of the cases the changes spontaneously disappeared after a period of several months. If antiluetic treatment was given the disappearance was somewhat more rapid.

The differential diagnosis included developmental marks, scorbutic bands, transverse shadows of hypermineralization following intensive antirachitic treatment, phosphorus sclerosis, etc.

The condition was observed in 37 cases, a number of the more illustrative roentgenograms being reproduced in the text.—*T. Leucutia.*

CONTAMIN, N., and POUZET, F. Forme particulière de syphilis osseuse héréditaire de la deuxième enfance. (A peculiar form of hereditary syphilis of the bone in childhood.) *J. de radiol. et d'électrol.*, Nov., 1930, *14*, 603–605.

The authors observed two rather unusual cases of hereditary syphilis of the bone, the first in a girl five years and the second in a girl eight and a half years of age. In both instances the process was localized to the metaphyses (in the first, in the lower metaphysis of the right femur and in the second, in the lower metaphysis of the right radius), the epiphyses remaining entirely clear.

The roentgen appearance was that of a vacuolar destruction of the metaphyses with marked thickening of the epiphyseal line. The metaphyses as a whole were slightly enlarged, and there was evidence of some reactive periostitis. Following antiluetic treatment, healing ensued in both instances, though the roentgenograms several years later still revealed a densification of the metaphyses, with calcification and marked irregularity of the epiphyseal lines.

The interesting feature of the two cases is that the lesion was localized to the metaphyseal region, producing a rather peculiar roentgen appearance. The condition must be placed either in the group of gummatous osteomyelitis or more probably in the group of ossification disturbances. A complete healing is possible.—*T. Leucutia.*

DAVIS, JOHN S., and GERMAN, WILLIAM J. Syndactylism (coherence of the fingers or toes). *Arch. Surg.*, July, 1930, *21*, 32–75.

A comprehensive treatise on webbing of the fingers and toes. The subject matter deals with the classification of syndactylism, the embryology, comparative anatomy, pathology, inheritability, incidence and treatment.

Syndactylism may be either congenital or acquired. The latter usually follows severe trauma or burns. The authors describe many of the operative procedures that have been devised for the cure of syndactylism. These descriptions are accompanied by diagrams which clearly illustrate the technique employed. No single operation, however, can be used successfully for all degrees of webbing.

It has been found advisable not to separate the fingers completely and reconstruct the new commisure until the child is at least six years old, as the work will have to be repeated in the majority of cases if it is done too early.

A summary of the cases that have been treated by the authors is given. Accompanying are numerous roentgenograms that illustrate the types of skeletal deformities to be encountered in syndactylism. Such osseous abnormalities are highly important from the standpoint of treatment and the end-results to be obtained. —*Karl Kornblum.*

AGATI, DINO. Osso vesaliano bilaterale del piede. (Bilateral Vesalius's bones of the feet.) *Radiol. med.*, June, 1930, *17*, 683–688.

The author describes a case in a young man of twenty-four who was a football player. One day in a game he was kicked on the dorsolateral surface of his foot; two hours later he had sharp pain for which he went to a physician who sent him for roentgen examination. The spontaneous pain had stopped but pressure between the process of the calcaneus and the base of the 5th metatarsal caused some pain. Roentgenoscopy showed an abnormal bone shadow between the cuboid and the end of the 5th metatarsal. The latter bone did not have a pointed end as normal but was blunted and had a convex outline. This suggested that the abnormal shadow was not a fractured fragment but an anatomical anomaly. This was confirmed by finding a similar bone on the other side. Very few cases of this kind have been described and the supernumerary bones in this case were different in form and larger in size than in the cases previously described. The author reviews the theories in regard to the pathogenesis of these bones and compares the char-

acteristics of his case with those of the other cases described in the literature. He thinks the bones in his case were epiphyseal in origin but thinks that the sport indulged in by the young man may have contributed to their development. He then discusses the differential diagnosis of such a Vesalius's bone from a sesamoid bone of the peroneus longus and from fracture of the tuberosity of the 5th metatarsal.—*Audrey G. Morgan.*

Spiller, Ulrich. Multiples Myelom, Spondylarthritis deformans and senile Osteoporose an der Wirbelsäule. (Multiple myeloma, spondylarthritis deformans and senile osteoporosis of the vertebral column.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Aug., 1930, *42*, 191–205.

The author describes in detail 2 cases of multiple myeloma of the vertebral column in which a correct diagnosis could be made only after post-mortem examination. In connection with the 2 cases he emphasizes the peculiar roentgen appearance of the spine in multiple myeloma. As a rule, there is a localized bone destruction of one or several vertebral bodies, with generalized demineralization of the entire spine, giving a picture similar to that observed in spondylitis deformans or senile osteoporosis. The problem becomes still more complicated when there is absence of involvement of the long bones.

Similar changes of the vertebral column were found in 3 other cases of multiple myeloma which were more or less generalized, involving other bones of the skeleton and in which consequently the diagnosis encountered no difficulties. These cases are also described in detail.

The conclusion is reached that whenever a patient complaining of pain in the spine shows a roentgen appearance similar to that of spondylitis deformans or senile osteoporosis, the possibility of multiple myeloma must be kept in mind. Roentgen examination of the long bones and skull, as well as the demonstration of Bence-Jones bodies in the urine, will in some instances help to substantiate the diagnosis; in others a differentiation may appear impossible. —*T. Leucutia.*

Bower, John O., Clark, Jefferson H., and Davis, Leon. The management of giant cell sarcoma of the vertebrae. *Arch. Surg.*, Aug., 1930, *21*, 313–329.

A report of a case of giant cell tumor of the vertebra treated by the implanation of radium. The patient was well and apparently cured five years later. Twenty-seven additional cases from the literature are analyzed. From this study the following conclusions are drawn.

1. Giant cell tumors of the vertebrae should not be considered benign as compared with giant cell tumors of bone elsewhere.

2. While there is a tendency for them to regress normally they also possess the tendency to metastasize rarely, to recur commonly and to produce cachexia invariably.

3. The proximity of the spinal cord and nerve roots interferes with radical measures (operation). In a percentage of cases the growth begins in the body of the vertebra. This makes complete removal impossible. Regardless of where the lesion originated, removal is usually associated with profuse hemorrhage, necessitating packing, which increases the possibility of infection.

4. Exploratory operation; curettage, partial or complete removal evidently stimulates these abnormal cells to further activity. In over half of the cases (52.4 per cent) there were local recurrences.

5. Part of the high mortality is due to the improper interpretation of the roentgenogram. If the bodies of the vertebrae are affected, extension of the disease is rapid, the intervertebral discs are clear and early symptoms of a lesion of the transverse cord present themselves, one should suspect a malignant condition.

6. The best treatment for this type of tumor is the insertion of radium into or near the growth with as little trauma as possible. Giant cells are peculiarly susceptible to the radium rays. The closed method of operation should be used because of the possibility of infection.—*Karl Kornblum.*

Geschickter, C. F., and Copeland, M. M. Tumors of the giant cell group. *Arch. Surg.*, July, 1930, *21*, 145–156.

On the basis of histogenesis, the authors have shown the fundamental pathologic relationship between various forms of giant cell tumors which have heretofore been considered under separate headings and as individual entities. They have attempted to show that these tumors form a group which in itself is a pathologic entity. The lesions in this group comprise the bone cyst, the giant cell tumor in the

long bones and the skull, the epulis of the alveolar border and giant cell tumors of the xanthoma group found in the tendon sheaths.

The Bone Cyst. This lesion occurs in patients under twenty-one and is usually found in the metaphysis of the long bones, especially the upper end of the femur, the humerus and the tibia. In the average case the lesion is of about 2½ years' duration when first observed. Histologically the cyst is surrounded by fibrous tissue and new bone. The latter is formed from osteoblasts derived directly from fibroblasts without passing through a cartilaginous stage. The authors regard this new bone formation as a healing and not an inflammatory reaction as it has heretofore been considered. This repair process is nonspecific as it also occurs about foreign bodies in the bone, abscesses in the medullary cavity, giant cells tumors, secondary metastatic tumors of the bone and even about primary bone sarcoma. Osteitis fibrosa of which the bone cyst is but a variety, is therefore not an entity but a healing reaction around an area of bone destruction.

Histologic Variants of the Bone Cyst. The question arises as to what is the original bone destructive process in the bone cyst. When such lesions of short duration, six months or less, are examined, it is found histologically that much of the lesion is made up of giant cells and tissue characteristic of giant cell tumor. Such cysts are classified as giant cell variants of osteitis fibrosa. It is believed from this observation, therefore, that the bone cyst in the long bones is a healed or healing giant cell tumor. Likewise typical giant cell tumors show to a varying degree tissue characteristic of osteitis fibrosa.

The next question to arise is why the giant cell tumor in the epiphysis fails to heal and is a progressive lesion, whereas the bone cyst which arises close to the same region, the metaphysis, presents a predominantly healing reaction. The explanation of this lies in the fact that the epiphysis lacks the defensive mechanism represented by the thick cortex and the rich, vascular osteogenic layer of the metaphysis.

Nature of the Giant Cell Tumor. The conclusion that the usual bone cyst is an arrested giant cell tumor carries us into the study of the nature of the giant cell tumor in the quest for the origin and etiology of this lesion. Embryologic studies have led to the conclusion that the giant cell tissue observed in giant cell tumors corresponds in nature and structure with a normal phase in the substitution of calcified cartilage by permanent bone.

The Rôle of the Giant Cell in the Histogenesis of Bone. The penetrating rôle of the giant cell which in the embryo comes from the periosteum and provides for vascularization and the resorption of temporary bone, is believed by the authors to be duplicated in giant cell tumor.

Giant Cell Tumors of the Skull. While most of the bones of the skull are derived from membrane rather than cartilage, it was found that 22 giant cell tumors of the skull could be traced to those bones or portions of bone formed from cartilage. Thus giant cell tumors of the skull are brought in line with the theory that giant cell tumors are related to the proliferation of osteoclasts in bone newly formed from cartilage.

Epulis. This term has been rather loosely applied to all tumors occurring on the alveolar border of the jaws. A form of epulis containing giant cells is a recognized pathological entity. Of this, there are two varieties, the giant cell and the fibroid type. A study of a series of epulides of this group has shown that they are related to the process of the resorption of the temporary bony structure of the deciduous teeth. The giant cells of these tumors are related to the odontoclasts responsible for the loosening and shedding of the deciduous teeth. The giant cell epulis is comparable to the giant cell tumor of long bones while the fibroid epulis represents osteitis fibrosa, or the healing reaction.

Giant Cell Tumors of the Xanthoma Group. Giant cell tumors of the tendon sheaths which have long been erroneously classed under the heading of xanthoma, are in reality tumors of the sesamoid bones. Sesamoid bones are derived from white fibro-cartilage; thus this group of tumors is brought into line with the conception of giant cell tumor advanced throughout this paper.

Etiology of the Giant Cell Tumor. The authors believe that trauma is the primary factor in the production of giant cell tumors and related lesions. Trauma occurring in an epiphysis or metaphysis at a time when osteoclastic activity is at its height causes an imbalance between bone destruction and bone construction and results in a bone destructive lesion characterized by a preponderance of giant cells. The relatively weaker defensive mechanism in the epiphysis results in a giant cell tumor, while in

the metaphysis where an attempt at healing occurs osteitis fibrosa or the bone cyst is the resultant lesion.

That metabolic factors may enter into this problem is evident by the association in certain cases showing multiple lesions of the giant cell tumor variety with diseases such as rickets, osteomalacia, syphilis and fragilitas ossium.

When all these factors are considered, it is apparent why both bone cysts and giant cell tumors are rare in comparison to the frequency of trauma. Only when the bone destructive phase of giant cell proliferation is in the ascendency for a significant period do the clinical entities of giant cell tumor or osteitis fibrosa arise. The factors concerned in the ascendency of such giant cell proliferation are listed (by way of summary) in the order of their importance as: (1) A normal histogenic proliferation of giant cells which occurs only in calcified cartilage or the temporary bone of the roots of deciduous teeth. (2) Injury and necrosis of an area of cortical bone overlying an actively ossifying epiphyseal or metaphyseal region. (3) A response on the part of giant cells and capillaries in cancellous bone to the need for collateral circulation. (4) Disturbance in the calcium and phosphorus metabolism inhibiting the normal growth and defensive reaction of cortical bone. —*Karl Kornblum.*

SUBJECT INDEX TO VOLUME XXV

(abs) = Abstract. (E) = Editorial

Abdomen, importance of urography in interpretation of symptoms connected with (abs), 412
opaque structures in (abs), 296
Abrodil, excretion pyelography with (abs), 830
Abscess, subphrenic (abs), 409
Abscesses, post-appendicial, roentgen appearance (abs), 698
Achondrodysplasia, hereditary deforming: see Exostoses
Acid-base balance and serum proteins of dogs before and after irradiation, 255
Addison's disease, value of radiography in direct diagnosis (abs), 550
value of roentgen examination of suprarenal glands in (abs), 703
Adenocarcinoma of cervix, prognosis of, treated by radiation therapy (abs), 712
Adnexal disease, kidney and ureteral lesions secondary to (abs), 297
Aerophagy (abs), 826
American College of Physicians, notice of meeting, 281
American Radium Society, entertainment of, at Philadelphia meeting, 523
notice of meeting, 281
program of, 671
American Roentgen Ray Society, preliminary program, 810
Aneurysms, calcified, of splenic artery and splenomegaly (abs), 829
Angina pectoris, physiotherapy in (abs), 122
Aorta, and heart, fluoroscopic studies of, in acquired and congenital syphilis (abs), 407
coarctation of, roentgen diagnosis (E), 385
further studies of, with special reference to luetic aortitis (abs), 407
isthmus stenosis (coarctation) of (abs), 824
roentgen diagnosis of stenosis of descending arch (coarctation) of, 243
Aortitis, syphilitic, roentgen diagnosis (abs), 407
syphilitic, studies of aorta with special reference to (abs), 407
Apparatus for ionometric control (abs), 574
for projection of roentgen films and prints without reduction in size (abs), 143
for superficial application of radium (abs), 121
high tension, roentgen examination in sickroom with (abs), 140
immobilizing, for taking chest roentgenograms in young children, 100
latest modification of Westminster teletherapy (abs), 571
new nomogram for roentgen (abs), 142
permitting horizontal stereoroentgenography (abs), 574
roentgen, for circa 400 kv. tube tension (abs), 140
roentgen, significance of inductive precision regulation and distant control of (abs), 575
special, for detail pictures in contrast examinations—spiral diaphragm compressor (abs), 133
Arthropathy of the hip in a tabetic (abs), 114
Asthma, bronchial, roentgen therapy (abs), 122, (abs), 430
Atelectasis: see Lungs, collapse
Azygos lobe: see Lungs

Basedow's disease: see Goiter, exophthalmic
Béclère, Antoine, portrait opposite p. 667
president of Third International Congress of Radiology (E), 667
Belden, Webster W., obituary (E), 387
portrait opposite p. 387
Resolutions of New York Roentgen Society on death of, 388
Beta rays, secondary, significance, in problems of gamma ray therapy (abs), 576
Bismuth compounds, roentgen pictures following intramuscular injection of (abs), 144
Bladder, submucous fibrosis of outlet of, in infancy and childhood (abs), 297
tumors, treatment, 375
Blaine, Edward S., goes to California, 813
Blood, changes in catalase and lipase content of, of patients treated with roentgen rays (abs), 574
characters, transmission through blood injection of, acquired by sympathetic roentgen therapy (abs), 134
circulating, biological action of rays on (abs), 144
effect of radiation on acidity of, 271
formula changes following irradiation with Bucky rays (abs), 135
Bone, development of, studies in embryology (abs), 414
experimental healing of, after parathyroidectomy (abs), 832
growth injury of, following therapeutic irradiation (abs), 125
in poliomyelitis, fragility and deficient healing of (abs), 706
knowledge of changes in, in congenital syphilis (abs), 835
lesions, in tabes and syringomyelia (abs), 113
peculiar form of hereditary syphilis of, in childhood (abs), 836
repair, histological study of early phases of (abs), 832
roentgen appearance of changes in, of congenital lues (abs), 834
solitary cysts of, of long duration (abs), 418

stimulation of growth of, by venous stasis (abs), 417
suppuration and renal calculi in children (abs), 834
syphilis of (abs), 552
Bones and joints, neuropathies (abs), 415
Book Reviews
Diseases of the Skin. A Text-Book for Practitioners and Students. By George Clinton Andrews, 103
Selected Readings in the History of Physiology. Edited by John Farquhar Fulton, 104
Étude Clinique et Radiologique des Ostéites Condensantes Bénignes (Ostéites Picnotiques). By Paul-Marie Bernard, 105
Allgemeine Grundlagen. Physik und Technik des Röntgenverfahrens. (Radiologische Praktika. Band XIV.) Von M. Brenzinger, A. Janitzky and E. Wilhelmy, 287
La Roentgenthérapie: Ses Indications Cliniques. By Iser Solomon, 287
The Origin of Lymphosarcomatosis and its Relation to other Forms of Leucosis in White Mice—Lymphomatosis Infiltrans Leucemica et Aleucemica. (Acta radiol., Suppl. X.) By Carl Krebs, Hans Christian Rask-Nielsen and Aage Wagner, 288
Intestinal Tuberculosis: Its Importance, Diagnosis and Treatment. A Study of the Secondary Ulcerative Type. By Lawrason Brown and Homer L. Sampson, 403
The National Physical Laboratory. Report for the Year 1929, 403
The Chest. By L. R. Sante, 538
Physics of Radiology. By J. L. Weatherwax, 538
Practical Radiation Therapy. By Ira I. Kaplan, 539
Röntgentherapeutisches Hilfsbuch. By Robert Lenk, 540
Normale Anatomie des Kopfes im Röntgenbild. II. Teil. (Radiologische Praktika, Band XIII.) By Karl Goldhamer, 684
Das Röntgenverfahren. Ein Lehrbuch fur den Arzt und die technische Assistentin. By Kurt Kirschmann, 684
A Textbook of Surgery. By John Homans, 817
Artificial Sunlight: Combining Radiation for Health with Light for Vision. By M. Luckiesh, 817
Borderline rays, blood formula changes following irradiation with (abs), 135
determination of size of field in treatment with (abs), 137
general treatment of skin diseases with (abs), 558
late injuries following treatment (abs), 119
problems of dosage and clinical application (abs), 138
use of, in some dermatoses (abs), 123
Bordier method in Heine-Medin's disease and late results of irradiation (abs), 120
Bowel, extra-bowel pathology, 474
Brain, encephalography in cases with fixed lesions of (abs), 688
roentgen treatment of tumors of (abs), 559
increased pressure of, skull changes in (abs), 821
tumors, arterial encephalography as method for localization (abs), 290
tumors, results of roentgen treatment (abs), 424
Breast, cancer, histological structure, clinical grouping and prognosis (abs), 126
cancer, radium treatment, 250
cancer, recent advances in radium therapy, 247
cancer, response of various types to radiation (abs), 562
British Institute of Radiology, invitation from, to American radiologists, 527
Bronchi, diagnosis of foreign bodies of (abs), 291
dilatation of, in infant, giving picture of mediastinal pleurisy (abs), 292
Bronchiectasis, treatment (abs), 110
Bronchitis, fibrinous, complicated by massive atelectasis (abs), 543
roentgen appearance of various forms of (abs), 824
Bronchus, probable posterior mediastinal empyema perforated into (abs), 292
Brooklyn Roentgen Ray Society, 99
Bucky principle, history of diaphragming roentgen rays by use of, 396
Bucky rays: see Borderline rays

Calcification: see also Ossification
of meniscus of knee joint, 85
of nucleus pulposus, new observation (abs), 113
Calculus, renal, radiography during operation for (abs), 413
Caldwell Lecture, 1928, 177
Cambridge diploma, 527
Cancer: see also Carcinoma; Tumors, malignant, etc.
deep, principles of roentgen therapeutic technique in (abs), 569
experimental glycemia, radiations (abs), 573
influence of roentgen irradiation on resistance to, in white mice (abs), 135
Institute of Faculty of Medicine of Paris (abs), 140
of breast, radium treatment, 250
of breast, recent advances in radium therapy of, 247
of breast, response of various types to radiation (abs), 562
of buccal mucosa, results of treatment by operation and radiation (abs), 425
of cervix and breast, histological structure, clinical grouping and prognosis (abs), 126
of cervix, effect of radium on (abs), 129
of cervix, radiation therapy of, at anticancer center of suburbs of Paris, 1921–1926 (abs), 713
of esophagus, roentgen diagnosis (abs), 111

of female pelvic organs, radiology as complete or partial substitute for surgery in treatment of (abs), 431
of mouth, radiation technique for (abs), 126
of tongue, radium treatment (abs), 561
of uterus, organization and conditions of efficiency in fight against (abs), 714
of vagina, radium treatment (abs), 432
post graduate lectures on, 812
present methods of treatment and results (abs), 569, (abs), 570
problem, present and future, 793
tissue, histiolytic effect of radium irradiation (abs), 119
treatment of, with radiations of long wave length (abs), 119
CAPILLAROSCOPY, study of roentgen erythema by means of (abs), 121
CARCINOMA, epidermoid, of cervix uteri, variation in radiosensitivity (abs), 564
genital, report of results of operation and irradiation between 1917 and 1927 (abs), 712
inoperable, of cervix uteri, results of radiation therapy (abs), 711
intraoral, PH of human mixed saliva during irradiation of, 266
metastatic testicular, of the rib, 632
of cervix (abs), 127
of cervix, choice of therapeutic methods on basis of clinical and anatomico-pathologic forms (abs), 709
of cervix, immediate response observed in treatment of, with radium (abs), 565
of cervix, operable, should it be radically operated upon or irradiated? (abs), 711
of cervix, preliminary irradiation (abs), 711
of cervix, results of treatment, 359
of colon, role of x-ray in diagnosis (abs), 113
of female genitalia, supplementary methods of irradiation (abs), 431
of rectum and anal canal, 210 cases treated between 1914 and 1925, 654
of rectum, treatment by radium, 644
of skin, extensive, stubborn and recurrent, radium treatment in (abs), 420
of uterus, action and dosage of rays from observations on irradiated (abs), 432
of uterus, effect of roentgen and radium irradiation on metabolism of patients afflicted with (abs), 713
of uterus, operation or irradiation (abs), 711
of uterus, results of treatment from 1918 to 1930 (abs), 710
of uterus, technique of radium and roentgen treatment, 364
of uterus, vagina and ovaries, radiation therapy as complete or partial substitute for operation in treatment of (abs), 709
radon seeds in treatment of (abs), 571
with tuberculosis of stomach (abs), 696
CASTRATION, temporary, with roentgen rays (abs), 133
CATARACT, roentgen, and its prevention (abs), 568
CATHODE RAYS, high voltage, effects of, upon germinal epithelium of rat (abs), 131
physics and technique of (abs), 137
CAVITY in pulmonary tuberculosis, genesis and further developments, 454
CECUM, inflammatory tumors of (abs), 411
CEPHALOMETRY, and pelvimetry, intrauterine roentgen, 758
fetal, in utero (abs), 700
CHEST, immobilizing apparatus for taking roentgenograms of, in young children, 100
CHILDREN, bone suppuration and renal calculi in (abs), 834
gastromegaly and chronic duodenal ileus in (abs), 410
peribronchial infiltration in (abs), 291
roentgen treatment of tonsils in (abs), 429
young, immobilizing apparatus for taking chest roentgenograms of, 100
CHOLECYSTOGRAPHY: see also Gall-bladder
consideration of, on basis of 100 examinations (abs), 828
improvements of results with diathermy (abs), 113
intravenous, application of, and liver function test as employed in office practice, 590
oral, five years' experience with, 602
oral, necessity for accurate technique in, 595
CHONDRODYSPLASIA (abs), 707
CHONDROMATOSIS, articular, of the elbow, case of (abs), 704
of joint capsule (abs), 704
of joints (abs), 114
CHRISTIAN'S SYNDROME (abs), 290
CIRRHOSIS, tuberculous atelectatic, of the lung, roentgen significance, 620
COARCTATION of aorta (abs), 824
of aorta, roentgen diagnosis, 243, (E), 385
COCCIDIOIDAL GRANULOMA, roentgen diagnosis, 715
COLITIS, chronic, roentgen examination in (abs), 294
conditions commonly called, 308
COLON, carcinoma, role of x-ray in diagnosis (abs), 113
chronic hyperplastic tuberculosis of, 324
chronic hyperplastic tuberculosis, of, a further note, 676
diverticula of, roentgen diagnosis (abs), 698
diverticulitis of (abs), 295
fundamentals in roentgenology of (abs), 545
polyposis of (abs), 548
technique of stereoroentgenography of, by ascending route (abs), 548
COOLIDGE TUBE functioning at 400,000 volts constant tension (abs), 573
CRETINS, myxedematous, lesions of skeleton and articulations in (abs), 706
CYST, calcified hydatid, of inferior lobe of left lung (abs), 725

hydatid, of spleen, case of (abs), 700
hydatid, present inefficiency of penetrating radiotherapy and diathermy (abs), 560
hydatid, two cases of (abs), 110
intrathoracic dermoid, case of (abs), 110, (abs), 825
Cysts, lipiodol pelvic (abs), 700
solitary, of bone, of long duration (abs), 418

Dermatology, roentgen dosage in (abs), 423
Dermatoses, use of borderline rays in (abs), 123
Diabetes insipidus and osteitis fibrosa polycystica (abs), 706
Diaphragm, eventration secondary to spontaneous pneumothorax (abs), 544
induced paralysis of (abs), 826
inflammation of (abs), 408
left-sided eventration, etiologic mechanism (abs) 544
massive hernia of, without diagnostic symptoms (abs), 111
Diaphyseal aclasis: see Exostoses
Diverticula, duodenal, associated with gastric ulcer (abs), 112
of duodenum, roentgen appearance (abs), 696
Diverticulitis of colon (abs), 295
Diverticuloids of duodenum, roentgen appearance (abs), 696
Diverticulosis, colonic, roentgen diagnosis (abs), 698
Diverticulum, epibronchial, of esophagus, in patient with tumor of stomach (abs), 825
false, of the stomach (abs), 595
Dosage, biological, problem of, in deep therapy (abs), 139
determination in interstitial radiation (abs), 569
radiation, with Sabouraud-Noiré tablet (abs), 137
roentgen, in dermatology (abs), 423
roentgen, in skin diseases (abs), 421
tissue, calculations of, in radiation therapy, 490
Dose, divided, in treatment of cancer (abs), 570
single large, in treatment of cancer (abs), 569
Doses, tolerance, in roentgen diagnosis (abs), 140
Duodenum, deformities and obstructions of (abs), 409
extrabulbar ulcer of (abs), 827
method of roentgenoscopy of (abs), 696
mobile, roentgen picture (abs), 826
niche of, a criterion in healing of duodenal ulcer (abs), 696
stasis of (abs), 294
submesocolic stenosis of (abs), 827
tuberculous ulceration, 88
Dwarfism due to disordered epiphyseal development, 91

Editor, new departmental (E), 386
Effect, biological, of rays on circulating blood (abs), 144
biological, of short wave radiation on metabolism of the cell (abs), 575
biological, of various qualities of roentgen rays (abs), 138
histiolytic, of radium irradiation in cancer tissue (abs), 119
of high voltage cathode rays upon germinal epithelium of the rat (abs), 131
of high voltage roentgen radiation upon fertility and motility of sperm of rabbit, 81
of radiation on acidity of blood, 271
of roentgen irradiation on healing of wounds (abs), 423
of roentgen radiation on histological structure of mouse ovaries, study of, 1
of roentgen rays on heart, toleration dose for myocardium of rats, 635
of roentgen rays on offspring (abs), 133
of roentgen rays on resistance to cancer in white mice (abs), 135
systemic, of roentgen rays, 255
Elbow, case of articular chondromatosis of (abs), 704
primary nerve lesions in injuries of (abs), 416
Emanation therapy and physiological dosage (abs), 575
Embryo, roentgen rays and injury of (abs), 566, (abs), 567
Encephalography, arterial, as method for localization of brain tumors (abs), 290
explanation of a possible error in technique, 754
in cases with fixed lesions of the brain (abs), 688
new position used in, 533
subdural hematoma shown by, 512
Epiphyseal separation of lesser femoral trochanter (abs), 553
Epiphyses, dwarfism due to disordered development of, 91
of femoral head, peculiar change of (abs), 705
peculiar change of, in entire skeleton (abs), 833
Epithelioma of cervix, radiotherapy of, at Radium Institute of Paris (abs), 713
of penis, treatment of (abs), 567
of skin, radium treatment (abs), 559
ulcerated roentgen, cured in single treatment by diathermo-coagulation (abs), 121
Epithelium, germinal, of rat, effect of high voltage cathode rays (abs), 131
Erythema nodosum in children, etiology; its relation to early tuberculous infection (abs), 419
Erythema, roentgen, study of, by means of capillaroscopy (abs), 121
Esophagus, cancer, roentgen diagnosis (abs), 111
epibronchial diverticulum of, in patient with tumor of stomach (abs), 825
imperforation of (abs), 693
method for measuring lumen of (abs), 825
new technique for roentgen study of stenosis of (abs), 293

EVENTRATION, diaphragmatic, secondary to spontaneous pneumothorax (abs), 544
left-sided, etiologic mechanism of (abs), 544
EWING, JAMES, testimonial dinner in honor of, 391
EXOSTOSES, diaphyseal aclasis; hereditary deforming achondrodysplasia (abs), 414
EXTREMITIES, of boys and girls, irregular ossification of, 330
EYE, neuro-epithelioma of retina and chiasm in child aged five (abs), 543
EYES, chronic inflammatory diseases, roentgen treatment (abs), 425
protection of, in using roentgen and radium rays (abs), 424

FEET, bilateral Vesalius's bones of (abs), 836
FEMUR, anomaly of ossification of neck of (abs), 704
changes in head of, after complete intracapsular fracture of the neck (abs), 831
peculiar changes in epiphyses of head of (abs), 705
treatment of fracture of (abs), 417
FETUS, does indirect radium irradiation cause late injury of (abs), 566
syphilitic, unusual changes in centers of ossification in (abs), 705
FIBROMYOMA, uterine, roentgen treatment (abs), 124
uterine, treatment and end-results (abs), 128
FILMS, exposed, light-proof box for storing, 683
FISTULAE, biliary, considerations and contributions to study of (abs), 828
diagnostic significance of filling of (abs), 142
FOOT, supernumerary (abs), 552
FOREIGN BODIES of bronchi, diagnosis (abs), 291
FOREIGN BODY, unusual migration of, 802
FRACTURE, double isolated, of spine (abs), 551
of neck of femur, following radiotherapy of thyroid gland (abs), 554
FRACTURES of anterior superior portion of os calcis due to indirect violence, 629
pathological (abs), 706
treatment of, in delayed union by venous stasis (abs), 417

GALL-BLADDER, blood supply of (abs), 694
cholecystographic diagnosis of papillomas of, 46
normal, visibility of (abs), 549
wall of, petrification of (abs), 694
GAMMA RAYS, measurement of distribution of, around a four-gram mass of radium (abs), 572
significance of secondary beta rays in problems of therapy with (abs), 576
GANGRENE, arteritic, suprarenal roentgen therapy (abs), 118
GASTRITIS, segmental toxic, of the antrum (abs), 826
GASTRODUODENAL roentgen diagnosis, compression technique (abs), 111
GASTROINTESTINAL TRACT, tumors outside of, 474
unusual tumors of (abs), 411
GASTROMEGALY and chronic duodenal ileus in children (abs), 410
GERM CELL, male, roentgen injury and the offspring (abs), 131
injuries by roentgen rays (abs), 133
GERMAN ROENTGEN CONGRESS, eighth, in Prague, 524
GOITER, exophthalmic, associated with Mikulicz's syndrome (abs), 426
exophthalmic, results and indications of radiotherapy in (abs), 560
exophthalmic, roentgen treatment (abs), 426, (abs), 427
exophthalmic, roentgen treatment of, in elderly women (abs), 428
malignant, radium treatment (abs), 428
GOUT and gouty rheumatism (abs), 708
GRID DIAPHRAGM, evolution of present forms of, 396
flat, analysis of, and some less excentric forms, 677
principle applied to roentgenography of paranasal sinuses, 814
principles underlying, which limit its form and efficiency, 528
GRIPPE, roentgen studies of lung in, during epidemic of 1928–1929 (abs), 691
GROWTH CENTERS, osteochondritis of (abs), 704
GYNECOLOGY, present day questions in radiotherapy in (abs), 562
radium in (abs), 564

Hand, cleft (abs), 413
HAUDEK, MARTIN, obituary notice (E), 520
HEAD, device for measuring diameters and contours of cross-section of, 536
HEART, and aorta, fluoroscopic studies in acquired and congenital syphilis (abs), 407
congenital idiopathic enlargement of, 320
diseases of, radiotherapy (abs), 430
effect of roentgen rays on; toleration dose for myocardium of rats, 635
in children, roentgen evaluation of size of (abs), 823
lesions of valves of, roentgen picture of lungs in (abs), 824
HEARTS, histological findings in, exposed to radiation during treatment of adjacent organs (abs), 135
of men engaged in athletics, observations on (abs), 694
HEIDENHAIN-FRIED treatment of inflammations (abs), 434
HEINE-MEDIN'S disease, Bordier method in treatment of, and late results of irradiation (abs), 120
HEMATOMA, subdural, shown by encephalography, 512
HEMORRHAGE, uterine, without demonstrable pathology, 349
HERNIA, congenital diaphragmatic (abs), 409
diaphragmatic, case of gastric triloculation with (abs), 595

massive diaphragmatic, without diagnostic symptoms (abs), 111
Hickey, Preston M., an appreciation, 171
bibliography of, 150
Caldwell lecturer, 1928, 173
his relation to the American Roentgen Ray Society, 168
his relation to the Medical School, University of Michigan, 158
his relation to the University of Michigan, 156
his work with the American Medical Association, 168
memorial library, 393
note on the military career of, 169
obituary notice, 145
portrait opposite p. 145
Resolutions of American Roentgen Ray Society on death of, 176
Resolutions of Detroit Roentgen Ray and Radium Society, 176
the scientist, 170
the teacher, 161
Hip, arthropathy of, in a tabetic (abs), 114
History of diaphragming roentgen rays by use of the Bucky principle, 396
of discovery of roentgen rays, 437
Hyperparathyroidism as etiology of osteitis fibrosa cystica generalisata, 739
Hypertrichosis, roentgen injury after epilation by irradiation in (abs), 558
Hypophysis, tumors of, roentgen diagnosis and therapy (abs), 424
Hysterosalpingography, technique (abs), 549

Ileus, chronic duodenal, and gastromegaly, in children (abs), 410
Illinois Radiological Society, 811
Infancy and childhood, submucous fibrosis of bladder outlet in (abs), 297
Inflammations, treatment with Heidenhain-Fried method (abs), 434
irradiation for preventing (abs), 436
of glandular organs, roentgen therapy (abs), 435
Injuries produced by roentgen rays and other radiant energy (abs), 134
Injury, and sores from x-ray, 394
of embryo by roentgen rays (abs), 567
of fetus, caused by indirect radium irradiation (abs), 566
roentgen, after epilation by irradiation in hypertrichosis (abs), 558
Insurance against malpractice hazards of the roentgen ray, 340
International Congress of Radiology, Third, 281, 674
Intervertebral disc (E), 805
Intestine, cases of congenital anomaly (abs), 112
folds of mucosa, new technique of roentgen examination (abs), 548
large, dystopy of, absence of ascending colon, inversed subhepatic cecum, biliary lithiasis (abs), 828
large, roentgen demonstration of polypoid lesions and polyposis of, 577
movements of, influence of phenolphthalein on (abs), 130
torsion of, in embryonal life and arrest of torsion, clinical and roentgen considerations (abs), 112
Intrabronchial drainage, its importance in the diagnosis and treatment of pulmonary suppurations (abs), 693
Invagination, acute, in children, roentgen examination of conservative non-surgical disinvagination of, under control of roentgen rays (abs), 698
acute intestinal, value of roentgen examination (abs), 697
chronic ileocecal, roentgen and anatomical report of case (abs), 697
Ionometer, apparatus for checking constancy of (abs), 574

Joint capsule, chondromatosis of (abs), 114, (abs), 704

Keloids, treatment of (abs), 558
Kidney, calculus, radiography during operation for (abs), 413
direct irradiation of (abs), 130
ectopic, calculus in (abs), 297
horseshoe (abs), 412
lesions of, secondary to adnexal disease (abs), 297
Knee, dislocation of (abs), 552
Kümmell's disease, with a report of a roentgenologically proved case, 749

Lead, none in tumor tissue after intravenous injection of colloidal lead (abs), 135
poisoning, roentgen sign in (E), 96
Leucemia, Mikulicz's syndrome in (abs), 418
Lienography, clinical application; new method for roentgen visualization of spleen and liver (abs), 699
Lipiodol, diagnosis of pseudo-cavities by means of (abs), 109
pelvic cysts (abs), 700
Liver, function test of, application of intravenous function test and, as employed in office practice, 590
new methods of roentgen visualization (abs), 699
Lung, and pleura, mesenchymatous tumors of (abs), 824
calcified hydatid cyst of inferior lobe of left (abs), 825
primary tumor of (abs), 110
suppurations of, importance of intrabronchial drainage in diagnosis and treatment of (abs), 693

tuberculous atelectatic cirrhosis of, roentgen significance, 620
LUNGS, azygos lobe; its visibility on pulmonary roentgenogram (abs), 109
azygos lobe, several cases (abs), 543
collapse, massive (abs), 544
collapse, massive, complicating case of fibrinous bronchitis (abs), 543
deformities and displacements of hila in sclerosis of, and adhesions of pleurae (abs), 691
lymphangitis carcinomatosa in, contribution to diagnosis of (abs), 693
roentgen picture of, in valve lesions (abs), 824
roentgen studies of, in grippe during epidemic of 1928–1929 (abs), 691
silicosis (abs), 109
syphilis of (abs), 691
technique of exposure of, with high power apparatus (abs), 141
LUXATION of semilunar and fracture of scaphoid (abs), 704
LYMPHANGITIS CARCINOMATOSA in lung, contribution to diagnosis of (abs), 693

MALIGNANCY INDEX, histological, determination of (abs), 126
MALPRACTICE hazards of roentgen ray and insurance against them, 340
MASTOIDS, method of obtaining a symmetrical picture of—anteroposterior oblique saggittal incidence (abs), 690
of infants, positive sign of extensive destruction (abs), 822
MEASUREMENT, biological, of scattered radiation (abs), 139
of diameters and contours of cross-sections of head and neck, device for, 536
of distribution of gamma rays around a four-gram mass of radium (abs), 572
of roentgen-ray applied intensity, discussion of methods used for, 74
of tube current in roentgenography (abs), 141
of voltage in very high millamperage (abs), 136
MEASUREMENTS, comparative, for dosage in superficial therapy (abs), 136
intensity, influence of temperature and atmospheric pressure on, in various ionization chambers (abs), 138
intensity, of radium rays (abs), 137
tension, in diagnosis (abs), 142
MEDICINE, coincidence in (abs), 129
MEDULLOBLASTOMAS, cerebellar, effect of roentgen radiation (abs), 120
MEGADUODENUM, case of, 381
MELORHEOSTOSIS (abs), 832
MENISCUS, calcification of, roentgen findings, 85
MESENTERY, common ileo-colic, with defective rotation, case of (abs), 827
METARSAL, fifth, unusual appearance of styloid epiphysis of (abs), 414
MICROCEPHALY, radiogenic, special reference to ophthalmic defects (abs), 543
MIKULICZ'S SYNDROME, associated with Basedow's disease (abs), 426
in leukemia (abs), 418
MINNESOTA RADIOLOGICAL SOCIETY, 527, 811
MOUTH, cancer of buccal mucosa; results of treatment by operation and radiation (abs), 425
cancer, radiation technique for (abs), 126
MUSCLE, atrophy, following therapeutic irradiation (abs), 125
MYELITIS, traumatic, due to fracture of the spine, roentgen findings in seventy-two cases, 65
MYELOMA, multiple, spondylarthritis deformans and senile osteoporosis of vertebral column (abs), 837
MYELOMATOSIS in a child aged eight (abs), 709
MYOMA, submucous (abs), 829
MYOSITIS OSSIFICANS, progressive, new case of (abs), 830

NECK, device for measuring diameters and contours of cross-sections of, 536
NERVES, primary lesions of, in injuries of elbow and wrist (abs), 416
NEURALGIA, roentgen-diathermy treatment (abs), 116
NEURO-EPITHELIOMA of retina and chiasm in child aged five (abs), 543
NEUROFIBROMA arising on pericardial pleura (abs), 293
NEUROMA, three cases of (abs), 298
NEUROPATHIES of bones and joints (abs), 415
NEWBORN, value of routine roentgen examinations (abs), 129
NOMOGRAM, new, for roentgen apparatus (abs), 142
NUCLEUS PULPOSUS, new observation on calcification (abs), 113

OFFSPRING, effect of post-conception pelvic irradiation on, in the albino rat (abs), 576
effect of roentgen irradiation on (abs), 133
effect of roentgen rays upon (abs), 133
injury of, during pregnancy from pelvic radiotherapy (abs), 543
roentgen injury of the male germ cell and the (abs), 131
OS CALCIS, fractures of anterior superior portion of, due to indirect violence, 629
OSSIFICATION, irregular, of extremities of boys and girls, 330
of femoral neck (abs), 704
unusual changes in centers of, in syphilitic fetus (abs), 705
OSTEITIS deformans, osteogenic sarcoma developed in (abs), 707
fibrosa cystica generalisata (abs), 705
fibrosa cystica generalisata, with hyperparathyroidism as etiology, 739
fibrosa cystica, generalized type, with giant cell sarcoma (abs), 550

fibrosa polycystica, diabetes insipidus and (abs), 706
Osteochondritis dissecans (abs), 550
of the growth centers (abs), 704
Osteomalacia, florid, changes of temporal bone in (abs), 690
Osteomyelitis, chronic, histology of postoperative healing process in (abs), 553
Osteopsathyrosis, idiopathic (abs), 708
Otolaryngology, applications of roentgen ray in, 188
Ovaries, mouse, study of histological structure, following exposure to roentgen irradiation, 1
Ovary, special resistance of, to roentgen rays (abs), 434

Papillomas of gall-bladder, cholecystographic diagnosis of, 46
Parathyroidectomy, experimental healing of bone after (abs), 832
Parotid gland, mixed tumors of, 507
Patella, tripartite, case of (abs), 114
Pelvimetry, and cephalometry, intrauterine roentgen, 758
roentgen, adaptation to fetal cephalometry (abs), 700
Pelvis, female, tuberculosis (abs), 549
Penis, epithelioma, treatment of (abs), 567
Peribronchial infiltration in children (abs), 291
Perivisceritis, painful, radiotherapy of (abs), 558
Pharyngeal ring, lymphatic, in children, roentgen treatment (abs), 429
Phenolphthalein, influence of, on intestinal movements (abs), 130
Pleura, pericardial, neurofibroma arising on (abs), 293
Pleural effusions, roentgen observations on movement of, 220
Pleurisy, mediastinal, bronchial dilatation in infant giving picture of (abs), 292
Pneumocephalus, traumatic, unusual case of, 800
Pneumonias, lobular, roentgen appearance (abs), 690
Pneumopyelography, technique of (abs), 700
Pneumothorax, 237
artificial, compression of tuberculous cavities by, 231
congenital (abs), 545
spontaneous, diaphragmatic eventration secondary to (abs), 544
Pneumoventricles, case of, following injury to the cranium (abs), 688
Poliomyelitis, fragility and deficient healing of bone in (abs), 706
infantile, treated with radiotherapy (abs), 118
Polypoid lesions of large intestine, roentgen demonstration, 577
Polyposis of colon (abs), 548
of large intestine, roentgen demonstration, 577
Post-mortem control of roentgen findings (abs), 142
Potter-Bucky diaphragm: see also Grid diaphragm.
construction of a new (abs), 136
Pregnancy, post-radiation (abs), 124
Prostate, roentgen treatment of, in retention of urine (abs), 435
Protection of eyes in using roentgen and radium rays (abs), 424
radiation (abs), 143
roentgen, and self-protective tubes, dosimetric investigations on (abs), 141
shield for, provided with a stool (abs), 140
Protector, integral, functioning of (abs), 143
Protracted fractional method of roentgen therapy (Coutard), 784
Pruritus ani et vulvae, roentgen treatment (abs), 567
Psittacosis; clinical and roentgen study of seven cases with post-mortem observations in one case (abs), 690
Pyelography: see also Urography
and urography by uroselectan (abs), 701
by intravenous injection of uroselectan (abs), 296
excretion, with Abrodil (abs), 830
with uroselectan (abs), 701, (abs), 702
Pyeloscopy—radioscopy of the kidney pelvis (abs), 703
roentgen (abs), 829

r-unit, cutaneous reactions measured in (abs), 144
significance of, for determination of dose of gamma rays of radium (abs), 138
Radiation division of University Gynecological Clinic of Munchen (abs), 709
output of the roentgen tube as determined by type of apparatus, 659
therapy, results of, in 12,455 patients treated at Photoroentgentherapeutic Institute of Naples during seven years (abs), 115
Radioactive bodies, preparation and manipulation of (abs), 572
Radiology, clinical, lessons on, 812
Radiosensitiveness, anemia, age of cells and (abs), 557
Radiotherapy, scientific basis of (E), 518
Radium, changes in technique of making apparatus for superficial application of (abs), 121
rays, intensity measurements of (abs), 137
therapy, internal, emanation therapy and biological dosage, theoretical foundations (abs), 576
therapy, present technique (abs), 571
therapy, statistics of five years of (abs), 117
treatment by, 482
tubes, distribution of radiation from (abs), 571
Radon, action on spinal cord (abs), 572
seeds in treatment of carcinoma (abs), 571
Rectum and lower sigmoid (abs), 828
carcinoma of, treatment of, by radium, 644
carcinoma of, 210 cases treated between 1914 and 1925, 654
Reticulo-endothelial system in tumor patients (abs), 134

RHEUMATISM, gouty, gout and (abs), 708
RIB, metastatic testicular carcinoma of, 632
RICKETS, renal—an undesirable designation? (abs), 706
renal, so-called, report of a case (abs), 833
ROENTGEN department, organization of (abs), 575
examination, new techniques of (abs), 548
examinations, value of routine, of newborn (abs), 129
intensity and milliamperage from different constant voltage machines (abs), 137
therapy, protracted fractional method of, 784
therapy, unusual indications for (abs), 419
tube, new transparent target, 451
tube, radiation output of, as determined by type of apparatus, 659
W. C., and discovery of roentgen rays, 437
ROENTGEN RAYS, applied intensity of, methods used for measuring, 74
discovery of, 437
history of diaphragming by use of Bucky principle, 396
influence of quanta upon biological effects of various qualities of (abs), 138
injury and sores from, 394
insurance against malpractice hazards of, 340
of 4 to 8Å, biological and therapeutic properties of (abs), 141
same effect produced with ultraviolet and roentgen rays (abs), 568
ROENTGENOGRAPHY, importance of secondary rays in (abs), 136
instantaneous exposures in (abs), 132
reduction of limits of error in, with extremely short exposures (abs), 142
total (abs), 143
ROENTGENOLOGICAL CONFERENCE, 99, 392
ROENTGENOLOGIST in industrial surgery, 336
ROENTGENOSCOPY of duodenum (abs), 696

SALIVA, human mixed, pH of, during irradiation for intraoral carcinoma, 266
SARCOMA, giant cell, of vertebrae, management (abs), 837
grape, in a child, healed case of (abs), 712
osteogenic, developed in osteitis deformans (abs), 707
osteogenic, treatment by means of irradiation, 761
uterine, a few cases treated by radiotherapy (abs), 710
SCAPHOID, accessory, unusual appearance (abs), 414
SCARS, hypertrophied, treatment of (abs), 558
SCATTERED RADIATION, biological measurement (abs), 139
SCIATICA, physiotherapeutic treatment (abs), 118
SCREEN, protective, of J. Belot (abs), 132
SECONDARY RAYS, importance during roentgenography (abs), 136
SILICOSIS, pulmonary (abs), 109
SINUSES, paranasal, grid diaphragm principle applied to roentgenography of, 814
SKELETON and articulations in myxedematous cretins, lesions of (abs), 706
SKIN, carcinomas, efficacy of radium treatment in extensive, stubborn and recurrent (abs), 420
diseases, roentgen dosage in (abs), 421
erythema for combinations of gamma and roentgen rays (abs), 420
general treatment of diseases of, with Bucky's borderline rays (abs), 558
radium treatment of epitheliomata of (abs), 559
treatment of roentgen ulcers of (abs), 422
SKIODAN, urinary tract roentgenography by means of, 314
SKULL, case of pneumoventricles following injury to (abs), 688
changes in increased brain pressure (abs), 821
SKULLS, some unusual x-ray findings in (abs), 821
SPERM of rabbit, effect of high voltage roentgen radiation upon fertility and motility of, 81
roentgen injury of, and the offspring (abs), 131
SPINA BIFIDA (abs), 414
SPINAL CORD, action of radon on (abs), 572
cystic dermoid tumor of (abs), 708
SPINE, cervical, special technique for roentgenography in profile of (abs), 133
cervical, study of malformations (abs), 113
double isolated compression fracture of (abs), 551
multiple myeloma, spondylarthritis deformans, and senile osteoporosis of (abs), 837
three cases of primary tumors of, successful result by roentgen rays (abs), 707
traumatic myelitis due to fracture of, roentgen findings in seventy-two cases, 65
tuberculosis of intervertebral articulations, 299
SPLEEN, new method for roentgen visualization (abs), 699
observation of case of hydatid cyst of (abs), 700
SPONDYLOSIS, rhizomelic, case of (abs), 551
STEREOMETRY by orthodiagraphic method of Beyerlen (abs), 143
STEREOROENTGENOGRAPHY, horizontal, apparatus for (abs), 575
STEREOROENTGENOMETRY, a method for mensuration by means of roentgen ray (abs), 575
STEREOSCOPE, trivision, multiple, revolving, 283
STOMACH, carcinoma and tuberculosis of (abs), 696
cascade, study of (abs), 595
deformities and obstructions of (abs), 409
diagnosis of nature of (abs), 294
false diverticulum of (abs), 595
pedunculated intragastric tumor, case of, 515
syphilis of (abs), 595
triloculation of, case of, with diaphragmatic hernia (abs), 595
tuberculosis, report of four cases (abs), 545
SUPRARENAL GLANDS, roentgen therapy of region of, in arteritic gangrene (abs), 118

value of roentgen examination of, in Addison's disease (abs), 703
Surgery, industrial, roentgenologist in, 336
Sympathetic system, action of roentgen rays upon (abs), 120
Syndactylism (coherence of fingers or toes) (abs), 836
Synovial membranes, articular, structure and function of (abs), 554
intraarticular endothelial tumors arising from (abs), 555
Syphilis, cardiovascular, differential diagnosis (abs), 692
congenital and acquired, fluoroscopic studies of heart and aorta in (abs), 407
congenital, knowledge of bone changes in (abs), 835
congenital, roentgen appearance of bone changes (abs), 834
electrocardiogram and teleroentgenogram in early (abs), 408
hereditary, of the bone, a peculiar form in childhood (abs), 836
late congenital (abs), 115
of bone (abs), 552
of stomach (abs), 595
pulmonary (abs), 691
Syringomyelia, bone lesions in (abs), 113
roentgen treatment of (abs), 119
Systemic spongio-epiphyseal dystrophy (abs), 833

Tabes, arthropathy of the hip in (abs), 114
bone lesions in (abs), 113
Technique, compression, in gastroduodenal roentgen diagnosis (abs), 111
for roentgenography in profile of cervical spine (abs), 133
of exposure of lungs with high power apparatus (abs), 141
of necroroentgenoscopy (abs), 142
Teeth, significance of roentgenogram of, and its interpretation (abs), 822
Temporal bone, changes of, in florid osteomalacia (abs), 690
Thorax, tumor of, unusual roentgen finding in (abs), 692
Thymoma, diagnosis and treatment (abs), 293
Thyroid gland, radiotherapy of, and fracture of neck of femur (abs), 554
Thyrotoxicoses, roentgen treatment (abs), 427
Tongue, and soft palate, roentgenography of, during pronunciation of vowels and consonants (abs), 291
cancer, radium treatment (abs), 561
Tonsils, inoperable, treatment with radium (abs), 130
radiation therapy (abs), 129
roentgen treatment of diseases of (abs), 560
roentgen treatment of, in children (abs), 429
Trochanter, greater, lesions of (abs), 418
lesser femoral, epiphyseal separation (abs), 553
Tuberculosis, chronic hyperplastic, of the colon, 324
chronic hyperplastic, of colon, a further note, 676
compression of cavities in, by artificial pneumothorax, 231
gastric, report of four cases (abs), 545
incipiens (abs), 109
of female pelvis (abs), 549
of intervertebral articulations, 299
pulmonary, and secondary intestinal (abs), 411
pulmonary, cavity in, 454
pulmonary, value of roentgen examination in, 209
relation of erythema nodosum to (abs), 419
suspected juvenile, evaluation of clinical symptoms and signs (abs), 823
with carcinoma of the stomach (abs), 696
Tularemia, pulmonary infection in, 241
Tumor, cystic dermoid, of spinal cord (abs), 708
metastatic giant cell, recurrent and so-called (abs), 555
of brain, results of roentgen treatment (abs), 424
of thorax, unusual roentgen finding in (abs), 692
osteogenic (abs), 125
pedunculated intragastric, 515
primary, of lung (abs), 110
tissue, no lead in, after intravenous injection of colloidal lead (abs), 135
Tumors, desmoid (abs), 557
inflammatory cecal (abs), 411
influence of reticulo-endothelial system upon growth of (abs), 134
intra-articular endothelial, arising from synovial membrane (abs), 555
intrathoracic, extrapleural granulation (abs), 693
malignant, investigations concerning growth of, in roentgen irradiated tissue (abs), 134
mesenchymatous, of lung and pleura (abs), 824
mixed, of parotid gland, 507
of bladder, treatment, 375
of brain, roentgen treatment (abs), 559
of giant cell group (abs), 837
of hypophysis, roentgen diagnosis and therapy (abs), 424
of spine, primary, three cases, successful result by roentgen rays (abs), 707
of stomach, diagnosis of nature of (abs), 294
radiosensitive, and tumors that should first be subjected to operation (abs), 125
unusual, of gastrointestinal tract (abs), 411

Ulcer, benign, occurrence on greater curvature, 464
duodenal; duodenal niche, a criterion in healing of (abs), 696
extrabulbar, of duodenum (abs), 827
gastric, associated with duodenal diverticula (abs), 112
peptic, diagnostic value of roentgen ray before and after treatment, 51

peptic, of Meckel's diverticulum and ileum (abs), 112
ULCERS, late roentgen (abs), 422
roentgen, of skin, treatment (abs), 422
tuberculous, of duodenum, 88
ULTRAVIOLET, same effect produced by ultraviolet and roentgen rays (abs), 568
UNIVERSITY OF MICHIGAN ROENTGEN SOCIETY, 812
UROGRAPHY: see also Pyelography
by means of skiodan, 314
excretion (abs), 412
importance of, in interpretation of abdominal symptoms (abs), 412
intravenous, 196; (abs), 702
UROSELECTAN, examination of urinary tract by means of (abs), 830
in vasography (abs), 701
intravenous injection, roentgen visualization of kidneys and urinary paths by (abs), 702
pyelography and urography by (abs), 701
pyelography by intravenous injection (abs), 296
pyelography with (abs), 701, (abs), 702
UTERUS, cancer, organization and conditions of efficiency in fight against (abs), 714
carcinoma, action and dosage of rays from observations on (abs), 432
carcinoma, effect of roentgen and radium irradiation on metabolism of patients afflicted with (abs), 713
carcinoma, operation or irradiation (abs), 711
carcinoma, results of treatment from 1918 to 1930 (abs), 710
carcinoma, technique of radium and roentgen treatment, 364
cervix, cancer, effect of radium on (abs), 129
cervix, cancer, histological structure, clinical grouping and prognosis (abs), 126
cervix, cancer, radiation therapy of, at anticancer center of suburbs of Paris, 1921–1926 (abs), 713
cervix, carcinoma (abs), 127
cervix, carcinoma, choice of therapeutic methods on basis of clinical and anatomicopathologic forms (abs), 710
cervix, carcinoma, immediate response observed in treatment of, with radium (abs), 565
cervix, carcinoma, preliminary irradiation (abs), 711
cervix, carcinoma, prognosis of, treated by radiation therapy (abs), 712
cervix, carcinoma, results of treatment, 359
cervix, epidermoid carcinoma, variation in radiosensitivity (abs), 564
cervix, epithelioma, radiotherapy of, at Radium Institute of Paris (abs), 713
cervix, inoperable carcinoma, results of radiation therapy (abs), 711
cervix, operable carcinoma, should it be radically operated upon or irradiated? (abs), 711
fibromyoma of, roentgen treatment (abs), 124
fibromyoma, treatment and end-results (abs), 128
fundus, isolated radium application to (abs), 712
hemorrhage of, without demonstrable pathology, 349
multiple-area intrauterine irradiation (abs), 123
sarcoma, a few cases treated by radiotherapy (abs), 710
vagina and ovaries, carcinoma, radiation therapy as complete or partial substitute for operation in treatment of (abs), 709

VASOGRAPHY, uroselectan in (abs), 701
VERTEBRAE, giant cell sarcoma of, management of (abs), 837
VERTEBRAL COLUMN: see Spine

WESTMINSTER teletherapy apparatus, latest modification (abs), 571
WOUNDS, effect of roentgen irradiation on healing of (abs), 423
WRIST, primary nerve lesions in injuries of (abs), 416

XERODERMA pigmentosum, its relation to question of individual hypersensitiveness to rays and to pathogenesis of tumors (abs), 120

AUTHOR INDEX TO VOLUME XXV

Adair, Frank E., 562
Adler, Karl, 575
Agasse-Lafont, E., 572
Agati, Dino, 836
Åkerlund, Å., 133
Alquier, A., 704
Altschul, Walter, 419, 435
Andrews, George C., 103
Anzilotti, A., 293
Arif, Chemsettin, 825
Arons, Isidore, 127
Aschner, Paul W., 112
Asdell, Sydney A., 81
Astier, André, 560
Auoduy, F., 708

Backmund, Karlheinz, 559
Badgley, Carl E., 299
Bailey, Percival, 120
Balestra, G. 824
Balfour, Donald C., 411
Barclay, A. E., 173
Bardachzi, Franz, 426
Bargen, J. Arnold, 308, 411
Barker, Lewellys F., 548
Barreau, 114, 573
Baumbach, Gottfried, 429
Baumeister, R., 141
Baumgartner, 829
Béclère, Claude, 549
Béclère, H., 698
Behnken, Hermann, 141
Belot, J., 132, 143, 573, 704
Benedetti, Umberto, 695
Berard, L., 706
Beretvas, Leopoldo, 120
Berger, Heinz, 137
Bernard, 132, 707
Bernard, Paul-Marie, 105
Bienvenue, 134
Bienvenue, A., 120
Bittencourt, Januario, 551
Blaine, E. S., 306
Bland, E. F., 407
Blass, Gustaf, 434
Bloodgood, J. C., 125
Blount, W. P., 707
Böhm, Alexander, 135
Boman, P. G., 111
Bonner, Lila M., 110
Boorstein, Samuel W., 413
Borman, Milton C., 834
Bouquet, H., 828
Bouwers, A., 143
Bowen, D. R., 230, 616
Bower, John O., 837
Bowie, Eleazar R., 336
Bowing, Harry H., 371, 482, 565, 644, 658
Braasch, William F., 196, 208
Bradley, Wm. N., 409
Brailsford, James F., 822
Braun, R., 138
Brenizer, Addison G., 409
Brenzinger, M., 287
Bronner, H., 830
Brown, Lawrason, 209, 403
Brown, Percy, 174
Brown, Philip W., 295
Brown, William L., 123
Brummer, K., 568
Brun, R. G., 688
Bruner, Edward, 422
Brunet, R., 118
Brunn, Harold, 693
Brunschwig, Alexander, 418
Büben, Iwan V., 432
Buchwald, K. W., 135
Buckstein, Jacob, 696
Burman, M. S., 414
Butler, P. F., 474, 481

Cade, Stanford, 561
Cairns, Hugh, 572
Caldwell, G. H., 130
Callender, George R., 293
Campbell, Meredith F., 297
Camplani, Mario, 113
Carling, Francis Rock, 571
Carrau, Antonio, 292
Carter, Ray A., 715, 738
Casati, Annibale, 692
Case, James T., 298, 545, 668
Cassar, A., 830
Castronovo, Ettore, 697
Chamberlain, W. E., 736
Chantraine, H., 136
Chaptal, 110, 825
Chaumet, G., 695
Chauvin, E., 700
Chizzola, G., 144, 293
Christie, Arthur C., 170
Clark, Daniel M., 533
Clark, Jefferson H., 837
Clark, Stanley, 339
Clephan, Dorothy F., 571
Cohen, Philip, 291
Cola, 116
Colaneri, 554
Colaneri, L.-J., 701
Cole, Lewis G., 471
Colston, J. A. C., 375, 380
Cone, Sydney M., 552
Conrozier, 109
Constantinesco, 701
Contamin, N., 836
Conte, Ettore, 114
Cooke, Robert V., 412
Coolidge, W. D., 171
Copeland, Murray M., 555, 837
Coryllos, Pol. N., 110
Costolow, William E., 247
Coutard, H., 569
Crane, A. W., 130, 150, 323
Craver, Lloyd F., 293
Cremer, Max, 568
Crespellani, Carlo, 690
Crothers, Bronson, 688

Dachtler, H. W., 629, 631
Dall'Acqua, V., 144, 826
Danecico, I., 828
Darbois, 544
Dariaux, André, 704
Dauolas, 134
Dautwitz, Fritz, 428, 566
Davis, Carl H., 129
Davis, John S., 836
Davis, Leon, 837
Davy, Leita, 255
de Renyi, Marguerite, 576
De Vecchi, Luigi, 704
Delherm, 119, 558
Delherm, Louis, 118
Delprat, Jessie P., 823
den Hoed, D., 137
Desgrez, 119
Desjardins, Arthur U., 125, 519
Dévé, F., 560
Devraigne, 693
D'Halluin, Maurice, 119, 573
Di Barbazza, J. A., 700
Diamant-Berger, L., 113
Dickey, Lloyd B., 419
Dillenseger, R., 708
Dioclès, 140
Doerffel, J., 138
Donaldson, S. W., 393
Doub, Howard P., 299, 642
Douglas, Harry, 418
Downes, Helen R., 271
Dresser, Richard, 739
Duncker, Hans, 567
Dunham, H. Kennon, 642
Duval, 544
Dyes, Otto, 557, 693, 826

Eberson, Frederick, 823
Edberg, Einar, 697
Eley, R. Cannon, 688
Eljasz, Anna, 115
Ellison, Richard T., 620
Emery, Edward S., Jr., 51
Emperaire, R., 700
Enfield, C. D., 515
Epstein, A., 434
Erdélyi, Josef, 821

Ernstene, A. Carlton, 243
Estapé, José Maria, 426
Evans, James A., 294
Evans, William A., 782, 802
Eyster, J. A. E., 407

Failla, G., 373, 392, 505
Falcox, A., 695
Farrell, John T., 111
Faulkner, Wm. B., Jr., 693
Feil, A., 572
Firor, Whitmer B., 590
Fishbein, Morris, 168
Fitzwilliams, Duncan C. L., 571
Flaszen, Julius, 119
Flecker, H., 703
Fling, H. T., 572
Forsdike, Sidney, 564
Frain, Ch., 693
Fraser, John, 708
Fraticelli, A., 297
Freund, Ernst, 705
Freund, Leopold, 430
Fricke, Robert E., 644
Fried, Carl, 435
Fuhs, Herbert, 558
Fukase, Shuichi, 423, 436
Fulton, John F., 104, 572

Gadreau, 829
Gaessler, E. O., 713
Gage, H. Courtney, 410
Gage, I. M., 707
Galdau, 826
Galdau, D., 550
Gally, 132, 707
Gatewood, 409
Gavazeni, Antonio, 294
Gendreau, J. E., 374, 505
German, William J., 836
Geschickter, Charles F., 555, 837
Ghimus, D., 833
Ghio, A., 824
Giuntoli, Lorenzo, 826
Glasser, Otto, 138, 437
Golden, Ross, 642
Goldfarb, Samuel J., 324
Goldhamer, Karl, 684, 694
Goldstein, Leopold, 543
Goldstein, M. J., 574
Gouin, 134
Gouin, J., 120
Granger, Amedee, 822
Gray, Aldred L., 631, 737
Greer, Alvis E., 691
Grier, G. W., 523
Grimmett, L. G., 572
Groves, E. W. H., 417
Guarini, C., 115
Guggisberg, Hans, 133
Guilbert, 143
Gunsett, A., 144
Gurdjian, E. S., 65
Gutmann, R.-A., 548
Gutzeit, 134
Gutzmann, Hermann, 291

Habs, H., 138
Hager, Benjamin H., 130
Haguenau, 707
Hall, E. Walter, 167
Hallermann, W., 824
Ham, Arthur W., 832
Hampton, A. O., 407, 739
Hanganut, Marius, 112
Harbin, Maxwell, 704
Haret, 143, 554, 693, 701
Harper, Fred R., 644
Hayer, E., 427
Hazen, H. H., 129
Healy, William P., 127, 370, 564
Hecht, G., 830
Heim de Balsac, F., 572
Heiman, Henry, 291
Heimbeck, Johnannes, 109
Herdner, R., 132
Herendeen, Ralph E., 418
Hermann, Heinrich, 140
Heyman, James, 431, 709
Hickey, Preston M., 177, 825
Hill, Luther L., 695
Hill, Walter C., 615
Hoede, Karl, 558
Hoffmann, Wolfgang, 424
Holfelder, Hans, 139
Holmes, George W., 320, 347, 615
Holthusen, H., 138
Homans, John, 817
Hubert, R., 711
Hueper, W. C., 553
Hueper, William, 126
Hufschmid, W., 427
Humphris, F. Howard, 567
Hutter, Karl, 702

Iacobovici, I., 828
Illick, H. Earl, 602
Ingraham, Ruth, 408
Israelski, Martin, 85

Jacobs, Arthur, 412
Jacobs, Minard F., 411
Jacobsen, Victor C., 131
Jacoby, Paul, 709
Jaches, Leopold, 206
Jaeger, Robert, 140
Jameson, Edwin M., 549
Janitzky, A., 287
Jaubert de Beaujeu, A., 688, 828, 830
Jendralski, Felix, 425
Jenkinson, E. L., 237
Johnson, Clayton R., 575
Jona, J. Leon, 703
Jones, R. Watson, 416
Joseph, Benjamin M., 550
Joseph, S., 834
Jugenburg, Anna, 428
Junghagen, Sven, 832

Kaboth, George, 712
Kaplan, Ira I., 124, 250, 254, 539
Karelitz, Samuel, 112
Katz, Traian, 702
Keene, F. E., 128
Keith, David Y., 358
Kelen, Béla, 422
Keller, Fr., 712
Keller, William L., 111, 293
Kienböck, Robert, 705
Kimbrough, R. A. Jr., 128
Kirklin, B. R., 46, 173, 346, 595, 617
Kirschmann, Kurt, 684
Klaften, E., 835
Knipping, Paul, 137
Knox, Leila Charlton, 129
Knuthsen, L. F. R., 567
Kohn, Jerome L., 100
Koiransky, Henry, 100
Konrad, Josef, 558
Kornblum, Karl, 207, 620
Kraemer, William H., 793, 798
Krebs, Carl, 288
Kress, Louis C., 359, 374
Kretschmer, Herman L., 702
Kreuscher, Philip H., 553
Kurtz, Chester M., 407
Küstner, H., 138

La Roche, M. O., 136
Labbé, Marcel, 544
Laborde, Simone, 713
Lacassagne, A., 710, 713
Lahm, W., 432
Lamarque, 110
Lamarque, P., 825
Lapidus, Paul W., 414, 553
Laquerrière, 558
Lash, A. F., 700
Leb, 829
Ledoux-Lebard, R., 549
Lee, Burton J., 253
Leech, Paul Nicholas, 169
Leeser, F., 834
Lenk, Robert, 540
Lepennetier, F., 143
Lessertisseur, 560
Leunda, Juan José, 292
Levin, Isaac, 657
LeWald, L. T., 313, 346, 472
Lewis, Raymond W., 418
Lifschitz, 113
Lindemulder, F. G., 512

Loeffler, Lothar, 131
Lovisatti, N., 120
Löw-Beer, Adalbert, 690
Lucas, Ernst, 693
Luckiesh, M., 817
Lucy, A., 118
Luigi, La Ferla, 117
Lyons, Clinton G., 381

MacDonald, Ralph, 706
McIndoe, Archibald H., 411
McKee, Elmer E., 409
McNamee, E. P., 616
McNealy, R. W., 706
Magnin, 109
Magoun, James A. H., 412
Mahar, 695
Maino, Mario, 121
Manges, Willis F., 208, 229
Markl, J., 575, 576
Markovits, Emmerich, 705
Martin, Charles L., 349, 358, 510, 615
Martin, Hayes E., 490, 506, 536, 568
Martius, Heinrich, 133, 566
Mason, James B., 557
Mathieu, Pierre, 118
Mattick, W. L., 135
Mautz, F. R., 138
Mayer, A., 711
Mayer, Leo, 552
Maynard, Edwin P., 408
Mayo, W. J., 172
Meigs, Joe V., 129
Merritt, Edwin A., 507, 511
Mesz, Natan, 708
Miescher, G., 569
Miller, Reginald, 410
Misske, Bruno, 690
Mitchell, Joseph I., 552
Monacelli, Mario, 119
Moniz, Egas, 290
Monroe, Robert T., 51
Moore, A. B., 168
Moots, Charles W., 412
Morel-Kahn, 119
Morison, J. M. Woodburn, 544
Morrison, L. B., 113
Morton, J. J., 417
Mouchet, Albert, 704
Müller, K. W., 141, 142
Murphy, Douglas P., 576
Murphy, John T., 346, 782
Murray, Joseph M., 1
Muzii, Mario, 825
Myers, J. Arthur, 104

Neef, Th. C., 140
Neill, William, Jr., 254, 373, 379, 632
Nemours Auguste, 548
Neworoschkin, J. P., 574
Nicolas, J., 121
Nicotra, Antonino, 695
Nordentoft, Jacob, 697
Novel, 706

O'Brien, Joseph P., 654, 658
Ochsner, Alton, 707
Ochsner, H. C., 314
Oka, Mitsutomo, 699
Olshevsky, Dimitry E., 451

Pack, George T., 420, 490
Packard, Charles, 139
Pancoast, H. K., 312, 471, 616, 736
Pankow, O., 133
Parker, Frederic, Jr., 129
Parker, Marian E., 454
Parry, L. D., 761
Pearse, H. E., Jr., 417
Pendergrass, E. P., 616, 754
Pérès, 134
Perussia, Felice, 420
Pescatori, Guido, 691, 703
Peterson, Edwin, 690
Pétrignani, R., 113
Pfahler, G. E., 347, 761, 783
Picarda, 701
Piccard, A., 576
Piffault, 114, 573
Pilot, I., 824
Pinner, Max, 454
Pohl, Rudolf, 698
Pohle, Ernst A., 635, 643
Poirot, 113
Poittevin, M., 136
Pollack, Herbert, 693
Pondé, Adriano, 543
Pop, Alexandru, 545
Porcher, P., 698
Portmann, U. V., 74
Potenza, Vito, 114, 827
Potte, N. W., 690
Potter, Hollis E., 396, 528, 677, 814
Pouzet, F., 836
Priesel, R., 835
Profitlich, P., 136, 142
Prussak, Leon, 708

Quick, Douglas, 504
Quimby, Edith H., 420, 490, 506

Raffo, Ernesto, 291
Raine, Forrester, 826
Ramsbottom, Albert, 408
Rankin, Fred W., 295, 480
Rask-Nielsen, Hans Christian, 288
Ratkoczi, Nandor, 696
Ratschow, Max, 701
Recasens, S., 709
Reeves, Robert J., 88
Regaud, Cl., 710, 714
Reid, William D., 692
Reinhard, M. C., 135
Reisach, Anselm, 712
Remer, John, 387
Remy-Roux, 110
Reuben, Mark S., 418
Reynolds, Lawrence, 96, 385, 805
Richards, T. K., 694
Rider, Dean L., 832
Rieder, Wilhelm, 427
Rigler, Leo G., 220, 230, 749
Ritvo, Max, 474
Robins, Samuel A., 243
Roederer, 113, 554
Ronneaux, 829
Rose, Cassie B., 821
Roy, 114
Roy Hartzell H., 414
Rubascheva, Anastasia, 694
Rubin, Eli H., 411
Ruggles, Howard E., 91
Russ, S., 571
Russo, C., 575
Ruthven, Alexander G., 157

Saidman, Jean, 141
St. Jianu, 828
St. Kartal, 704
Saley, D. H., 231
Sampson, Homer L., 209, 283, 403
Samuel, Ernest C., 336, 339
Sandera, Robert, 696
Sante, L. R., 241, 538, 616
Santos, Jose V., 831
Sashin, David, 552
Saul, Walter, 824
Sawtell, Ruth Otis, 330
Scal, J. Coleman, 130
Schatzki, R., 824
Schnack, A. G., 683
Schinz, H. R., 570, 575
Schmitt, Walther, 711
Schmitz, Henry, 126, 364, 374, 504
Schmitz, W., 141
Scholtz, W., 138
Schneider, Chester C., 551
Schönfeld, Herbert, 429
Schreiner, Bernard F., 359, 567, 654
Schreus, H. Th., 137
Schubert, Martin, 136
Schüller, J., 830
Schulte, G., 421, 560
Seisser, F., 562
Sergent, Emile, 109
Sgalitzer, Max, 140, 142, 702
Shands, A. R. Jr., 415

Sharp, George S., 266
Sighinolfi, Guiseppe, 827
Sigurdson, Larsus A., 554
Silveira, José, 543
Simmons, Channing C., 425
Simons, Albert, 558
Skinner, E. H., 657
Smokvina, Milan, 829
Solomon, 574
Solomon, Iser, 287
Sophian, Abraham, 706
Soulié, 544
Souttar, H. S., 571
Spârchez, Tiberiu, 545
Spalding, O. B., 690
Speed, Kellogg, 832
Spiethoff, B., 137
Spiller, Ulrich, 837
Sprague, Howard B., 407
Sproull, John, 464, 472
Sprunt, Douglas H., 696
Stacy, Leda, 372
Stahel, E., 576
Steel, David, 407
Stein, Jacob, 545
Steiner, Georg, 424
Stevens, G. W., 129
Stewart, William H., 481, 602, 618
Stoel, G., 137
Stuhl, L., 543, 544
Surmont, H., 548, 574
Surmont, J., 548 574
Sussman, Marcy L., 324, 676
Swart, Howard A., 833
Sylla, Adolf, 690

Taft, Robert B., 800
Tartagli, Dino, 112, 830
Thedering, Franz, 423
Thibaudeau, A. A., 135
Thompson, Theodore, 550
Thoms, Herbert, 700
Thoraeus, R., 137
Tiprez, J., 548, 574
Tixier, 829
Torelli, G., 122
Tumpeer, I. Harrison, 706
Turano, Luigi, 121, 296

Ullmann, Henry J., 372, 505, 657, 798

Vallebona, A., 295
Vampré, E., 290
van der Tuuk, J. H., 143
Van Wagenen, W. P., 414
Vigano, E., 123
Vincent, Cl., 543
Vischia, Q., 122, 292, 424
Viviani, Rodolfo, 827
Vogt, Edward C., 688
Voltz, Friedrich, 431, 709
v. Bernuth, F., 823
v. Jaschke, Rud. Th., 710
von Lichtenberg, A., 297

Wachtel, Heinrich, 119
Waggoner, R. W., 533
Wagner, Aage, 134, 135, 288
Wagner, Lewis Clark, 555
Walton, Henry J., 758
Wanvig, H. F., 340, 348
Ward, Roy, 559
Warren, Stafford L., 81
Warthin, Aldred S., 160, 635
Waters, Charles A., 590, 616
Weatherwax, J. L., 538
Weber, Harry M., 577
Weibel, W., 711
Wickham, Yves-Louis, 713
Widmann, B. P., 126
Wildman, Otis, 690
Wilhelmy, E., 287
Willan, R. J., 413
Windholz, Franz, 142
Wishard, W. N. Jr., 314
Withers, Sanford, 505, 797
Wolf, Arthur, 828
Wolff, Ernst, 823
Wood, Francis Carter, 124
Woodard, Helen Quincy, 271

Yates, J. L., 826

Zacherl, Hans, 134
Zakovsky, J., 659
Sawadowski, Witold, 109
Zimmern, A., 118
Zipperlen, Victory R., 430
Zollinger, Robert, 704
Zoppellari, T., 144
Zukschwerdt, L., 112
Zulich, J. Donald, 409
Zuppinger, A., 784
Zweible, Leonard, 414

VOLUME XXV JUNE, 1931 NUMBER 6

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

JUN 22 1931

Medical Lib

The AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

OFFICIAL ORGAN
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

Editor: LAWRENCE REYNOLDS, M.D.

Editorial Board

A. C CHRISTIE, M.D. E. H. SKINNER, M.D. WILLIAM DUANE, PH.D.

Advisory Board For Pathology

JAMES EWING, M.D. Cornell University
EUGENE L. OPIE, M.D. University of Pennsylvania
ALDRED S. WARTHIN, M.D. University of Michigan

ISSUED MONTHLY FOR THE AMERICAN ROENTGEN RAY SOCIETY
BY CHARLES C THOMAS, PUBLISHER, SPRINGFIELD, ILLINOIS

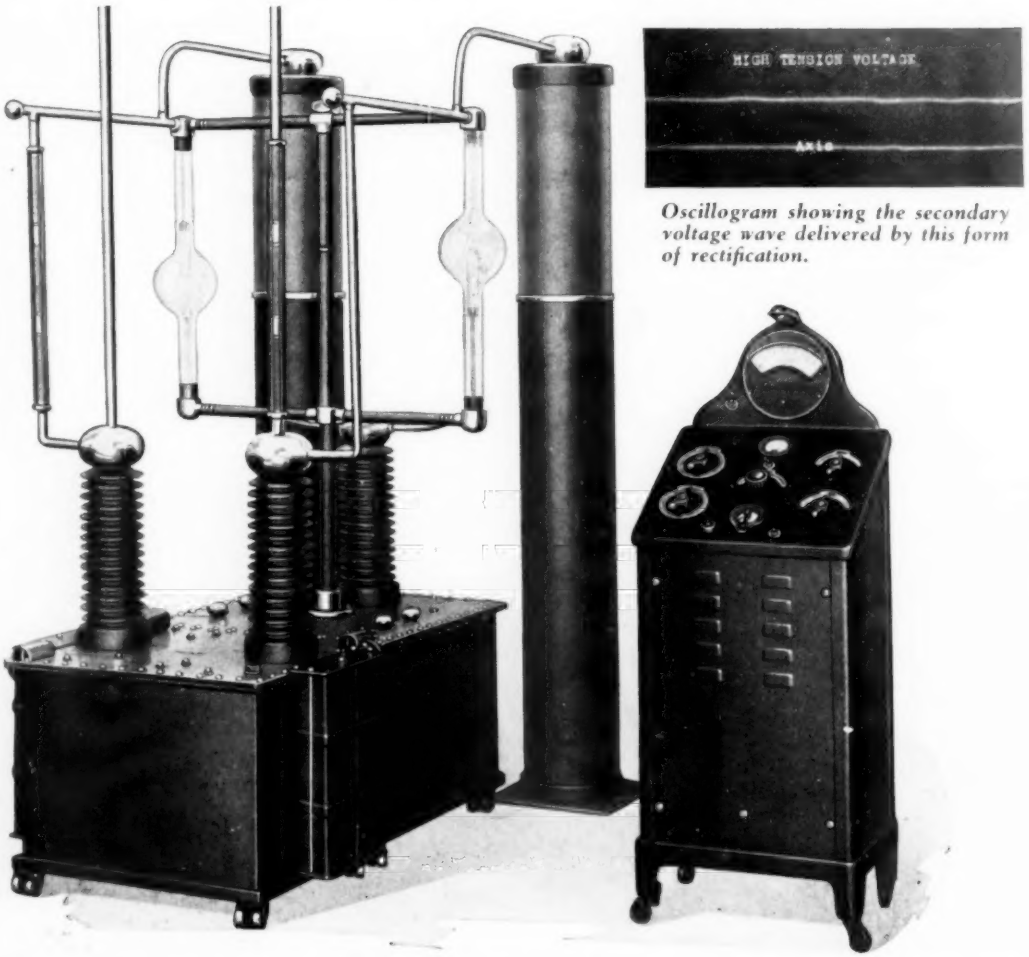
AMERICAN ROENTGEN RAY SOCIETY
Thirty-second Annual Meeting - Atlantic City, N. J., Sept. 22-25: 1931

AMERICAN RADIUM SOCIETY
Sixteenth Annual Meeting - Philadelphia, Pa., June 8-9: 1931

THIRD INTERNATIONAL CONGRESS OF RADIOLOGY
PARIS, FRANCE
July 27-31, 1931

YEARLY SUBSCRIPTION, $10.00 INDEX NUMBER SINGLE NUMBER, $1.50

The Keleket 230 K. V., 15 M. A. Stabilized Constant Potential Apparatus



Oscillogram showing the secondary voltage wave delivered by this form of rectification.

Keleket
X-RAY EQUIPMENT

As Modern
as Tomorrow

With this Keleket constant potential therapy apparatus, peak kilovolts are effective kilovolts.

A more homogenous radiation . . . greater intensity of X-ray beam . . . increased depth dose per skin reaction . . . complete avoidance of high-frequency generation . . . no sparking to the rectification . . . aerial of convenient length without destroying efficiency . . . even flow of constant voltage . . . these are some of the advantages of the Keleket Valve Tube Condenser Filtered Deep Therapy Apparatus.

Let us send you the details for study at your leisure.

The Kelley-Koett Mfg. Co., Inc.
203 West Fourth Street, Covington, Ky.

Without obligation, send complete story of Keleket Valve Tube Condenser Filtered Deep Therapy Apparatus.

Name .....
Street Address .....
City ..... State .....

THE STANDARD PRODUCT FOR GALL-BLADDER VISUALIZATION

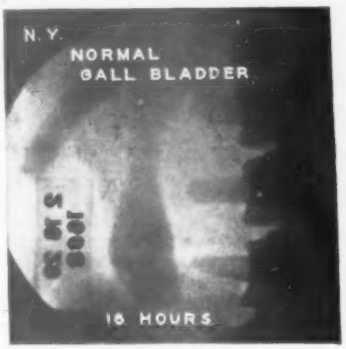
The Improved

KERAPHEN

USE IT ON YOUR NEXT DIFFICULT CASE

Set up twelve gall-bladder cases taken with Keraphen and compare them with twelve cases in which other dyes were used. Note the clearer, denser shadows produced by Keraphen and, still more important, the greater number of positive results . . . For the patient, Keraphen is easy and pleasant to take, is easily retained and produces no reactions.

Our booklet containing Directions to Patients, printed in 9 different languages, does much to eliminate unsatisfactory results caused by the failure of the patients to understand and follow the doctor's instructions. Copies of this booklet will be gladly sent without charge.



Equipment
Picker X-Ray Corporation
Accessories

PICKER X-RAY CORPORATION

300 FOURTH AVENUE : NEW YORK

739 Boylston Street
BOSTON

Superior Avenue at 30th Street
CLEVELAND

40 North Street
BUFFALO

90% of your Processing Troubles Disappear

when you use

EASTMAN PREPARED PROCESSING POWDERS

RADIOGRAPHY is essentially a chemical process involving very delicate reactions. For this reason, hot weather, which brings additional problems in radiographic procedure, focuses attention on the processing room. At this time your need for proper processing chemicals is most acute.

Eastman X-ray Developer Powders and Eastman X-ray Fixing Powders solve 90% of processing problems because only the purest chemicals are used in their preparation . . . They are constantly tested in Kodak Research Laboratories in order that the uniform quality necessary for time-temperature development may be maintained.

The same *dependable uniformity* is characteristic of Eastman X-ray Films—Diaphax or Ultra-Speed—because they are manufactured under the same scientific supervision. Make your exposure on *dependably uniform* Eastman X-ray Film, process with *dependably uniform* Eastman Prepared Processing Powders and you will record the highest radiographic quality, with economy and efficiency.

For a quarter hour of stimulating entertainment, tune in on "Devils, Drugs, and Doctors," broadcast each Sunday evening at 8 o'clock, New York time, over a coast-to-coast network of the Columbia System. These talks, sponsored by Eastman Kodak Company, are given by Dr. Howard W. Haggard, Associate Professor of Applied Physiology, Yale University.

EASTMAN KODAK COMPANY, *Medical Division*
349 State Street, Rochester, N. Y.

Gentlemen:

Without obligation, please send me "Radiography and Clinical Photography," which I understand is devoted to assisting the radiologist with his radiographic problems.

Name_____

Number and Street_____

City and State_____